Traffic Impact and Access Study

Assembly Square Mixed-Use Redevelopment

Somerville, Massachusetts

Prepared for

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Introduction

Vanasse Hangen Brustlin, Inc. (VHB) has completed a transportation impact analysis for the redevelopment of a significant portion of the Assembly Square District. The project involves the construction of a large scale mixed use development by the Proponent, Federal Realty Investment Trust (FRIT). The project is in keeping with the City's expressed goals for the Assembly Square District of creating a vibrant mixed-use community. The Project will contain a variety of office, residential and retail uses so as to create a self-sustaining "urban village" designed following smart growth principles. The mixture of use and overall site layout and configuration has been design to create a transit-oriented development in conjunction with the planned new MBTA Orange Line Station to be constructed adjacent to the site.

This study includes a thorough evaluation of existing traffic conditions, estimation of traffic impacts associated with the proposed redevelopment and suggested improvements for improving existing capacity deficiencies as well as to offset project related traffic impacts.

Site Context and Background

The proposed redevelopment is located within the Assembly Square Mixed-Use District, which is located at the northeast quadrant of the Route I-93/ Route 28 Interchange in Somerville, Massachusetts. A site location map is provided in Figure 1.

Regional access to the area is mainly provided via Route I-93 and Route 28. Primary access to the Assembly Square is provided through three "gateways": Route 28/ Middlesex Avenue, Route 28/Assembly Square Drive, and Mystic Avenue northbound/ Assembly Square Drive/ Lombardi Street. Circulation within Assembly Square is provided by several internal roadways including Middlesex Avenue, Assembly Square Drive, Foley Street and New Road. Figure 2 provides an

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Site Location Map Figure 1

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Figure 2

Assembly Square
Circulation Patterns

aerial photo of the Assembly Square area, highlighting traffic circulation patterns in the area.

Assembly Square consists of several parcels, most of them slated for redevelopment. An Assembly Square traffic master planning effort[1] was commissioned by the City to evaluate the impact of the full development of the Assembly Square Site. This report provides long-term transportation improvements to the area. These recommendations were incorporated, as appropriate, in the proposed improvements developed for this project. It should be noted that some of the redevelopment assumptions utilized in the master plan effort have since become outdated. Therefore, while the study's recommendations were used as a guiding tool, they were modified to reflect the more refined development assumptions while continuing to ensure adequate accommodation of the area's transportation needs.

In November 2001, The Sturtevant Partnership received a preliminary determination as the developer of the Yard 21 land parcel, which was subsequently sold to the current proponent Federal Realty Investment Trust. In 2003 IKEA completed the permitting process for the parcel located on the northeast quadrant of Assembly Square, but that project is currently under appeal. At this time, the former Assembly Square Mall has been fully re-tenanted as the Assembly Square Marketplace, which includes six prominent retail tenants.

Project Description

The project involves the redevelopment of the Yard 21 and permitted IKEA site portions of the Assembly Square site, along with land controlled by Federal Realty Investment Trust (FRIT). These areas currently consist of a variety of small uses including entertainment, retail, warehousing and manufacturing. The proposed mixed-use project consists of the construction of retail, residential and office space in several phases starting in 2010 and finishing in 2018. The project also involves relocating the proposed IKEA store from its currently approved location along the Mystic River waterfront. Finally, due to the outcome of a recent court case involving the City of Somerville zoning bylaws, the treatment of traffic generated by the Assembly Square Marketplace is complicated. The court's decision in effect dictated that the mall traffic be treated as current project trip generation for the purpose of this assessment. However, this shopping center is already an existing use generating traffic under present conditions. The exact manner in which this existing traffic on the roadway network was treated, given its classification as trip generation associated with the current project, is discussed in detail in the trip generation section of this assessment.

The project is planned to be constructed over six phases, some of which contain subphases. The timing of the commencement, delivery and stabilization of each

[1] Rizzo Associates Assembly Square Transportation Plan Final Report. May 13, 2003.

development phase is complex and dependent on a variety of factors. To properly analyze the traffic impacts and transportation infrastructure needs associated with the project it is important that the project be considered in a phased manner, and not just as the final overall development. However, analyzing each phase (and the corresponding required "No-Build" condition for each phase) would result in an unwieldy document. Instead, for the purpose of this assessment, VHB consolidated the planned FRIT development phases into more manageable segments as described below.

Given the size of the overall development it is apparent that the construction of the new MBTA station is critical to the success of the project. Accordingly, the following analysis focuses on the initial phases of development planned within the immediate future, followed by the subsequent phases of construction planned to occur before and after the construction of the new MBTA station. Within the overall 6+ phase development program planned by FRIT, VHB considered the following consolidated building program for the purpose of this analysis:

2011 "Short-term" phase:

- 310,000 square foot IKEA store
- 736 condominiums
- 300 apartments
- 192,795 square feet of retail.
- 328,806 sf Assembly Square Marketplace – already constructed/occupied

2014 "Mid-term" phase:

- 674 condominiums
- 390 apartments
- 238,165 square feet of retail space (including a 50,000 sf grocery store)
- 200-room hotel
- 62,000 movie cinema (assumed to include 14-screens)

2018 "Long-term" phase; full build-out:

- 1,750,000 square feet of office space
- 19,040 sf of retail space

The phases listed above are only being used for the purpose of this study to present a consolidated, yet precise, analysis. This phasing plan represents a consolidated version of the official phasing program envisioned by FRIT, which should remain as the official construction sequencing plan for the project. It also should be noted that an MBTA Orange Line station is envisioned to be constructed at the site between the mid-term and long-term phases around the year 2015.

Study Area

The study area for the project generally extends along Route 28 from Broadway to the northerly Assembly Square entrance, and along Mystic Avenue from Lombardi Street to west of Route 28. The major internal circulation roadways within Assembly Square (including Foley Street, Assembly Square Drive, and New Road) were also evaluated as part of this project. While the Route I-93/ Route 28/ Mystic Avenue interchange has already been identified by the state as needing significant improvements beyond the scope of this project, that interchange was also included within the project study area. As shown in Figure 3, Study Area Map, within these general boundaries, the study area encompasses the following intersections:

- Route 28 (Fellsway) at Assembly Square Drive
- Route 28 (Fellsway) at Middlesex Avenue
- Route I-93/Route 28/Mystic Avenue interchange
- Route 28 (McGrath Highway) at Broadway
- Broadway at Lombardi Street
- Mystic Avenue southbound at Lombardi Street
- Mystic Avenue northbound at Lombardi Street/ Assembly Square Drive
- Mystic Avenue northbound at New Road
- Mystic Avenue northbound at Middlesex Avenue
- Middlesex Avenue at Foley Street

Study Methodology

This traffic assessment has been conducted in conformance with the Massachusetts Executive Office of Environmental Affairs (EOEA)/ Executive Office of Transportation and Construction (EOTC) and the City of Somerville Guidelines. The assessment was conducted in a multi-step process including three primary stages. The first stage involved an assessment of existing traffic conditions within the project area including an inventory of existing roadway geometry, observations of traffic flow, daily, and peak period traffic counts, and a review of traffic safety and pedestrian/bicycle facilities in the area.

The second stage of the study established the framework for evaluating the transportation impacts of the proposed project. Future traffic demands on the study area roadways due to projected background traffic growth and other proposed area development that will occur independent of the proposed development were determined along with the assessment of specific travel demand forecasts for the project. The project description section presented earlier in this chapter described the complex phasing program associated with the overall project. To properly analyze the traffic impacts and transportation infrastructure needs associated with the project it is important that the project be considered in a phased manner, and not

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Study Area Map Figure 3

just as the final overall development. Even with the consolidated phasing program considered for this assessment, multiple Build and corresponding "No-Build" conditions must be analyzed to identify the project's impacts and transportation infrastructure needs. This is further complicated by the Assembly Square Marketplace portion of the project already having been constructed and occupied, and by the IKEA component being an approved entity, though at a different location within the Assembly Square District.

In the Project Description section of this chapter, a breakdown of the phasing considered in this traffic assessment was summarized. Table 1 presents an outline of how this phasing program ties in with the analysis conditions considered in this assessment.

Table 1
Federal Realty Investment Trust
Traffic Assessment Analysis Conditions Summary

Use	IKEA	Apartments	Condos	Hotel	Office	Cinema	Retail
Analysis Condition							
2006 Existing							238,594 sf*
Cumulative Total							238,594 sf*
2011 No-Build	277,000 sf						90,212 sf***
Cumulative Total	277,000 sf**						328,806 sf
2011 "Short-Term" Build	310,000 sf	300 units	736 units				192,795 sf
Cumulative Total	310,000 sf**	300 units	736 units				521,601 sf
2014 "Mid-Term" Build		390 units	674 units	200-room		14 screens	238,165 sf
Cumulative Total	310,000 sf**	690 units	1,410 units	200-room		14 screens	759,766 sf
2018 "Long-Term" Build					1,750,000 sf		19,040 sf
Cumulative Total	310,000 sf**	690 units	1,410 units	200-room	1,750,000 sf	14 screens	778,806 sf

* At the time of the traffic data collection, approximately 238,594 sf of the Assembly Square Marketplace was occupied.
** A 277,000 sf IKEA store has been approved to be constructed along the Mystic River waterfront, but is currently under appeal.
*** The remaining 90,212 sf of the Assembly Square Marketplace (Staples, A.C. Moore and Sports Authority) were constructed and occupied following the traffic data collection phase of this study and will be analyzed under the No-Build condition.

The 2006 Existing Conditions analysis is based on existing traffic volumes and conditions observed by VHB. As shown in Table 1, the Assembly Square

Marketplace is listed as being part of the existing conditions analysis even though a recent court decision dictates that it be considered as part of the current FRIT project. While this shopping center is included in the overall project totals, the traffic associated with it must remain as part of the existing conditions analysis as that traffic is already in place.

Under the 2011 No-Build Condition the trip generation associated with the remaining Assembly Square Marketplace building area that was occupied after the traffic data collection was estimated and added the study area roadway network. Normal background traffic growth and site-specific background traffic not reflected in Table 1 was also incorporated into the analysis. Planned roadway improvements associated with the background projects were also incorporated into the analysis.

A unique situation exists with this assessment in which a proposed IKEA store is considered under both the No-Build and Build conditions. IKEA has received permits to construct a mixed-use development consisting of approximately 533,000 square feet including a 277,000 IKEA store, approximately 208,000 square feet of office space and 48,000 square feet of retail on the northeastern portion of Assembly Square. Although the current proposed project includes the relocation of the IKEA store to a separate portion of the site, once pending appeals have been resolved, IKEA could conceivably occupy its original site provided it implemented the improvements to which it is committed. Therefore, it is appropriate to include this project in the No-Build conditions along with the proposed transportation improvements associated with it, since in the event the currently proposed project does not proceed IKEA would likely return to its original design and location. The approval of the project included both the approval of the building sizes, locations, and other design elements as well as the traffic that was associated with that project. Since the original approval, VHB has updated the IKEA trip generation database and has revisited the effect of transit on IKEA's traffic. However, for consistency with the original study the approved traffic volumes associated with that project (along with the associated mitigation) have been used for the No-Build analysis.

The 2011 "Short-Term" Build condition analysis was utilized for consistency with standard EOEA/EOT guidelines, and also to coincide with early stages of the overall FRIT development program. Included under this condition is both the 310,000 sf IKEA store along with the residential and retail uses listed in Table 1. Both of the subsequent development phases are built upon the phase which precedes it, with the traffic associated with the additional building area being added to the network.

The third and final stage involved conducting traffic analyses to identify both existing and projected future roadway capacities and demands. From this information and other factors, the likely traffic impacts associated with the project can be determined. This analysis was used as the basis for determining if any resulting roadway improvements or measures would be required to accommodate the future traffic. While not specifically listed in Table 1, No-Build conditions corresponding to the 2014 "Mid-Term" Build and 2018 "Long-Term" Build conditions were also analyzed. This was done so that a direct comparison could be provided between design year conditions with and without the project. Where mitigation measures were deemed appropriate, additional "Build with mitigation" analyses are also presented.

2

Existing Conditions

Evaluation of the transportation impacts associated with the proposed project requires a thorough understanding of the existing transportation system in the project study area. A complete inventory and evaluation of the existing transportation system in the study area was conducted. The analysis of existing transportation conditions is based on the existing network, roadway and intersection geometry, traffic control, existing daily and peak hour traffic volumes, traffic safety conditions, and existing public transportation and pedestrian facilities. A detailed description of existing conditions within the study area is presented in this section.

Roadway Geometry

A mixture of residential, commercial and industrial uses characterizes the study area. Both Route I-93 and Route 28 provide regional access to the Assembly Square area. The principal roadways within the study area are described briefly below.

Arterial Routes

Interstate 93 (I-93)

Route I-93 is a freeway that provides four travel lanes in each direction through Somerville. Route I-93 runs in a north/south direction, starting at the junction of I-95/128 in Canton to the south and continues northerly to New Hampshire. I-93 is also the major commuter route linking communities from the north and the City of Boston and it provides convenient connections to I-95/128, I-495 and numerous local roadways.

In the vicinity of the Assembly Square area, on- and off-ramps from I-93 northbound and southbound connect to Mystic Avenue northbound and southbound.

Route 28

Route 28 is an arterial roadway that generally runs in a north/south direction under the Department of Conservation and Recreation (DCR) jurisdiction. In the immediate vicinity of

the site, Route 28 is known as the Fellsway, while southeast of Mystic Avenue it is known as McGrath and O'Brien Highway. Approximately 0.5 miles north of Assembly Square, Route 28 intersects with Route 16 (Mystic Valley Parkway and Revere Beach Parkway) at the Wellington Circle Rotary.

Within the study area, Route 28 intersects Shore Drive, Assembly Square Drive, Middlesex Avenue, Puritan Road, Governor Winthrop Road, Bailey Road, Mystic Avenue northbound, and Mystic Avenue southbound. The Route 28 intersections with Assembly Square Drive, Middlesex Avenue, and Mystic Avenue (northbound and southbound) are signalized.

In the vicinity of Assembly Square, Route 28 is a 97-foot wide median divided roadway accommodating three traffic lanes in each direction. Parking is prohibited on both sides of the roadway. Right-of-way width varies between 125 feet and 230 feet. Land use in the adjacent area is a mix of commercial, retail, residential and recreational. The posted speed limit is 35 miles per hour (mph) both northbound and southbound.

Mystic Avenue

Mystic Avenue is a two-way roadway that is divided by I-93 with the northbound lanes located east of and parallel to I-93 and the southbound lanes located west of and parallel to I-93. Mystic Avenue accommodates three lanes northbound and two lanes southbound. Posted signs prohibit parking on Mystic Avenue in both directions and speeds in the vicinity of the site are 30 miles per hour. Land use in the area is a mix of commercial, retail, office, recreational and residential.

Running in a northwesterly direction, Mystic Avenue northbound intersects with Assembly Square Drive/Lombardi Street, New Road, the I-93 northbound on-ramp, Middlesex Avenue, I-93 northbound off-ramp and Route 28. Mystic Avenue southbound intersects with Wheatland Street, Fellsway West, Route 28, Kensington Avenue, the I-93 southbound on-ramp, the I-93 southbound off-ramp, Route 28 southbound connector, Garfield Avenue and the off-ramp to Lombardi Street. The intersections of Mystic Avenue northbound with Assembly Square Drive/Lombardi Street, New Road and Route 28, and the intersection of Mystic Avenue southbound with Wheatland Street and Route 28 are all signalized.

Assembly Square Access Roadways

Middlesex Avenue, Assembly Square Drive, Foley Street and New Road provide internal traffic circulation through the Assembly Square area. Middlesex Avenue and Assembly Square Drive both cross the area diagonally, connecting Mystic Avenue northbound with the Fellsway (Route 28).

Middlesex Avenue

Middlesex Avenue is a four-lane roadway that accommodates two travel lanes per direction and runs in a southeast to northwest direction from Mystic Avenue northbound to Route 28. Parking is allowed on designated segments of Middlesex Avenue. Land use in the adjacent area includes commercial, retail, industrial and office uses.

Assembly Square Drive (Sturtevant Street)

Assembly Square Drive (Sturtevant Street) begins at Mystic Avenue opposite Lombardi Street and runs diagonally across the Assembly Square area between the existing Home Depot/Loews plaza and the Good Times Billiards plaza. Assembly Square Drive is a 48-foot wide roadway providing two travel lanes per direction from Mystic Avenue to Foley Street. Assembly Square Drive narrows to a single travel lane per direction internally at the site. Land uses along Assembly Square Drive include commercial, industrial and retail development, as well as vacant land. Parking is prohibited on both sides.

Foley Street

Foley Street runs in an east/west direction, intersecting both Middlesex Avenue and Assembly Square Drive. Foley Street is a 48-foot wide roadway accommodating two lanes of traffic per direction. East of Assembly Square Drive, Foley Street narrows to a two-lane cross section following a curvilinear alignment, terminating at the eastern boundary of the Assembly Square Area. Parking is prohibited on both sides. Land use adjacent to Foley Street is a mix of commercial, retail and industrial uses, including Central Steel and a local taxi company. The intersection of Foley Street and Middlesex Avenue is signalized. However, due to malfunctioning signal equipment the intersection is presently operating in flashing red/yellow mode.

New Road

New Road is a four-lane, two-way, median-divided, 70-foot wide roadway that begins at Mystic Avenue northbound and terminates at Assembly Square Drive. Land use adjacent to New Road includes Home Depot and Circuit City, a movie theater and office space. Parking is prohibited along both sides of New Road.

Traffic Volumes

To estimate the existing operational conditions at the study area intersections, a review of existing condition traffic volumes was conducted. Daily traffic volume data were collected along Route 28 near Middlesex Avenue, Middlesex Avenue, and Foley Street adjacent to the site in January 2006. The observed traffic volume data are summarized below in Table 2.

Table 2
Existing Traffic Volume Summary

Location	Daily		Peak Hour								
			Weekday Morning			Weekday Evening			Saturday Midday		
	Weekday (vpd)*	Saturday+ (vpd)*	Vol. (vph)**	"K" Factor***	Directional Flow	Vol. (vph)**	"K" Factor	Directional Flow	Vol. (vph)**	"K" Factor	Directional Flow
Rte 28 south of Middlesex Ave	56,605	51,040	4,170	7.4	67% SB	3,880	6.9	56% NB	3,450	6.8	50%
Middlesex Ave north of Foley St	10,475	11,100	550	5.3	58% SB	760	7.2	62% NB	810	7.3	52% NB
Foley St east of Middlesex Ave	6,660	5,405	370	5.6	57% EB	495	7.4	60% EB	610	7.3	63% EB

Source: Automatic Traffic Recorder (ATR) counts conducted by VHB in January 2006.
* Daily traffic expressed in vehicles per day.
** Peak hour volumes expressed in vehicles per hour.
*** Percent of daily traffic, which occurs during the peak hour.
Notes: EB = eastbound, WB = westbound, SB = southbound, NB = northbound. Peak hours do not necessarily coincide with the peak hours of the turning movement counts.

As shown in Table 2, Route 28 carries approximately 56,605 vehicles on a typical weekday with 7.4 percent occurring during the morning peak hour and 6.9 percent occurring during the evening peak hour, while it carries 51,040 vehicles on a Saturday with 6.8 percent during the midday peak hour. Middlesex Avenue carries approximately 10,475 vehicles on a typical weekday with 5.3 percent during the morning peak hour and 7.2 percent during the evening peak hour. On a Saturday, it carries approximately 11,100 vehicles daily with 7.3 percent during the midday peak hour. Foley Street carries approximately 6,660 vehicles on a typical weekday with 5.6 percent and 7.4 percent during the morning and evening peak hours, respectively. On Saturday, it carries approximately 5,405 vehicles daily with 7.3 percent during the midday peak hour.

In addition, manual turning movement counts (TMCs) were conducted at the study area intersections during the weekday morning peak hour period (7:00 AM-9:00 AM), weekday evening peak hour period (4:00 PM-6:00 PM) and Saturday midday peak hour period (11:00 AM-1:00 PM) in January 2006.

■

Seasonal Variation

MassHighway Statewide Traffic Data Collection was reviewed for the month of January to determine seasonal variation in traffic volumes associated with urban roadways during these months. Based on the assessment, January traffic volumes are approximately 6 percent lower than the statewide average month traffic volume level for urban and arterial collector roadways. Therefore, the traffic counts were adjusted up by 6 percent to account for seasonal variations. The resulting 2006 Existing Conditions traffic volume networks for the weekday morning, weekday evening and Saturday midday peak hour are summarized in Figures 4 through 6.

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Route 28

Gov. Winthrop Road

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

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Figure 4

2006 Existing Conditions
Weekday Morning
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

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Figure 5

2006 Existing Conditions
Weekday Evening
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Assembly Square

Shore Drive

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

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Figure 6

2006 Existing Conditions
Saturday Midday
Peak Hour Traffic Volumes

Safety Assessment

To identify potential vehicle accident trends and/or roadway deficiencies in the project study area, the most current vehicle accident data for the study area intersections was obtained from MassHighway for the years 2002 to 2004. A summary of the study intersections vehicle accident history is presented in Table 3.

Crash rates are calculated based on the number of accidents at an intersection and the volume of traffic traveling through that intersection on a daily basis. Rates that exceed MassHighway's average for accidents at intersection in the district in which the town or city is located (District 4 for Somerville) could indicate safety or geometric issues for a particular intersection. The latest published crash rate by MassHighway in District 4 is 0.88 for signalized intersection and 0.63 for unsignalized intersections. These rates imply that, on average, 0.88 accidents occurred per million vehicles entering signalized intersections throughout District 4, and 0.63 accidents occurred per million vehicles entering unsignalized intersections. It should be noted that the location for some accidents cannot be precisely determined from the database. These locations typically involve interchange intersections. Additionally, some accidents may have occurred but were either not reported or not included in the database, and therefore not considered.

Review of the accident data indicates that the intersections of Mystic Avenue at Route 28 (which includes both the intersections at Fellsway and McGrath O'Brien Highway section of Route 28) and the intersections of Route 28 at I-93 had the highest number of accidents in the past. Because the location of the accidents could not be precisely decided, and thus accidents were combined, the crash rate at these locations was not calculated. Out of the total 207 accidents at this location, 142 were of the "angle" type. Previous studies indicate that, according to information provided by the Somerville Traffic and Parking Department, accidents at this location may be attributable to signal visibility. Field observations confirm that the poor visibility of the traffic signals due to the signal heads being mounted on a post, instead of a mast arm, as well as the placement of the posts is likely a major contributor to the high accident incidence at the intersection. In this situation, drivers who are traveling at high speeds must quickly stop when they realize the presence of a red signal indication. The other potential factor involves the length of the yellow and all-red clearances. The available clearance time may be too short relative to the travel speeds. Improvements at this location to correct these safety deficiencies were proposed by the previous IKEA project, and will be implemented as part of this project prior to completion of its first phase.

Table 3
Vehicular Accident Summary [2002 – 2004]

	Route 28 at:				Mystic Avenue at:				Broadway at:	Foley Street at:
	Assembly Square Drive	Middlesex Avenue	Mystic Avenue[a]	Broadway	Wheatland Street	Lombardi Street	New Road	Middlesex Avenue	Lombardi Street	Middlesex Avenue
Signalized?	YES	YES	YES	YES	YES	YES	NO	NO	YES	NO
Year										
2002	7	13	81	24	9	16	9	4	13	1
2003	2	10	72	18	2	4	3	2	4	3
2004	3	6	54	11	2	1	1	2	4	2
Total	12	29	207	53	13	21	13	8	21	6
Collision Type										
Angle	1	4	142	18	6	10	0	0	8	1
Head-on	0	1	2	0	1	0	0	0	1	0
Rear-end	8	15	39	18	2	5	8	3	4	1
Sideswipe	1	3	9	3	0	4	3	2	3	2
Single Vehicle Crash	2	2	7	6	0	1	1	2	2	0
Unknown	0	4	8	8	4	1	1	1	3	2
Total	12	29	207	53	13	21	13	8	21	6
Severity										
Injury	4	13	99	18	6	3	6	5	10	1
Property	8	13	89	22	5	14	5	3	4	4
Unknown	0	3	19	13	2	4	2	0	7	1
Total	12	29	207	53	13	21	13	8	21	6
Time of day										
Weekday, 7:00 AM-9:00 AM	0	2	9	7	1	2	0	0	3	1
Weekday, 4:00 PM – 6:00 PM	1	3	22	1	0	0	1	3	1	1
Saturday, 11:00 AM – 2:00 PM	0	0	7	2	0	0	0	0	0	0
Weekday, other time	8	17	114	31	10	11	8	4	10	2
Weekend, other time	3	7	55	12	2	8	4	1	7	2
Total	12	29	207	53	13	21	13	8	21	6
Pavement Conditions										
Dry	6	23	154	36	5	9	3	5	18	2
Wet	3	3	40	14	6	10	8	2	3	4
Snow	1	0	6	0	0	1	1	0	0	0
Icy	0	0	3	1	0	0	0	0	0	0
Other	1	1	1	0	0	0	0	0	0	0
Unknown	1	2	3	2	2	1	1	1	0	0
Total	12	29	207	53	13	21	13	8	21	6
MHD Crash Rate	0.21	0.49	N/A	0.77	0.47	0.63	0.48	0.31	1.04	0.61

Source: MassHighway database.
Note that it is not always possible, with the database, to determine the precise locations of accidents. Some locations have been combined in order to provide the most accurate information available.
N/A Indicates multiple locations; crash rate could not be calculated.
a. Includes accidents occurring at either Fellsway (Route 28) and Mystic Avenue or McGrath (Route 28) and Mystic Avenue.

The second highest accident occurrence within the study was reported at the intersection of McGrath Highway (Route 28) at Broadway, where 53 accidents were recorded from 2002 to 2004. Review of the accident data at this location indicates that 18 of the total 53 accidents

were "angle" type accidents and another 18 "rear-end" type. This location's crash rate is lower than the average rate for signalized intersections in the district.

Although the Broadway at Lombardi Street/Mount Vernon Street intersection's crash rate exceeds the district's average, it experienced an average of only 7 accidents per year (21 throughout the three year period).

All other intersections experience crash rates lower than the district's average.

Pedestrian Activity

A low level of pedestrian activity within Assembly Square was noted during field visits. No noticeable pedestrian activity was observed along the Mystic River waterfront either, as the Massachusetts Department of Conservation and Recreation (DCR) parkland in this area is presently underutilized. This can be attributed to several factors. First, the large-scale uses that currently exist within the Assembly Square District – Assembly Square Marketplace, GoodTimes Billiards plaza, various office/industrial uses – are physically spread out and are not connected by any cohesive network of pedestrian paths or walkways. Likewise, without the residential uses and additional office space planned as part of this project it will be difficult to achieve the vibrant pedestrian-friendly environment envisioned by the city. The proposed mixture of uses within the project site will help promote interaction between buildings and will promote walking in the area.

Beyond the interior of the Assembly Square District a variety of constraints exist that limit pedestrian and bicycle travel to and from the area. The Route I-93 overpass and ramp system creates a physical barrier to the southwest of the district which for the most part precludes pedestrians and bicyclists to pass. There are some areas where it is physically possible to travel underneath the overpass, but these routes follow an indirect path and are dark and uninviting. Prior consultation with the City identified potential safety concerns about promoting pedestrian traffic through this area as it is presently constituted.

Pedestrian and bicycle travel to the northwest of the Assembly Square District is inhibited by Route 28. While there are crosswalks and a protected signal phase at this location, pedestrians still must cross eight lanes of traffic. As a condition of its approval, IKEA had previously committed to provide $100,000 towards the study, design or construction of an undercarriage along the Mystic River waterfront. This would pass underneath Route 28 where the bridge over Mystic River begins and would connect to the existing pedestrian/ bicycle path that currently exists on the other side of Route 28 through the Ten Hills neighborhood. As discussed later in this report, this mitigation funding commitment remains in place even with the new proposed location for IKEA within the Assembly Square mixed-use development.

Public Transportation

There are currently three MBTA bus routes in the vicinity of the site. These routes in turn provide connections to additional MBTA bus routes and the rapid transit system. MBTA bus routes serving the general vicinity of the site include:

- Route 90, with service beginning at Davis Square in Somerville, providing local bus service through Somerville on Highland Avenue, McGrath Highway, Cross Street, Broadway to Sullivan Station, Assembly Square Mall and terminating at Wellington Station via the Fellsway and Revere Beach Parkway. Route 90 provides connections to the MBTA's Red Line at Davis Square and the Orange Line at the Wellington and Sullivan Square Stations. Weekday service begins at Davis Square with the inbound bus departing at 6:30 AM and the first bus arrival at Assembly Square at about 6:50 AM. Service continues throughout the day at 30 minute to hourly intervals. Weekday service ends with the last bus arriving at Davis Square at about 10:26 PM. Saturday service to Assembly Square is provided on an hourly basis with the inbound bus arriving at approximately 7:55 AM and the last bus leaving at 10:05 PM. No Sunday service is provided.

- Route 92, with service beginning in Assembly Square and continuing to Sullivan Square Station to Washington Street and Franklin Street in Downtown Boston via Main Street through Charlestown. It provides connections to the Orange Line at Sullivan Station, Haymarket Station and State Station, to the Green Line at Haymarket Station, the Red Line at Downtown Crossing Station and the Blue Line at the Government Center Station. Weekday service to Assembly Square begins at 9:20 AM and generally operates on 30-minute intervals. Regularly scheduled bus service to Assembly Square ends at 4:10 PM. Saturday service to Assembly Square begins at 9:20 AM and generally operates at 30-minute intervals with the last bus leaving at 6:20 PM. No Sunday service is provided.

- Route 95, with service beginning at Sullivan Station and continuing north on Mystic Avenue to Medford Center, High Street and West Medford Station and finally terminating at Winthrop Street in Medford. The northbound route provides stops on Mystic Avenue adjacent to the Assembly Square Mall. Passengers on the southbound route however, must travel to Sullivan Square and transfer to Route 90 or Route 92 heading north to Assembly Square.

The MBTA Orange Line and Commuter Rail (Haverhill Line) presently run in a north/south direction east of and adjacent to Assembly Square. The nearest Orange Line Station is located at Sullivan Square almost one mile to the south of the site. There are no commuter rail stops within the general vicinity of the site. Figure 7, Public Transportation Facilities, illustrates the available public transportation within the study area.

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Figure 7

Public Transportation Facilities

3

Future Conditions

To determine the impacts of the site-generated traffic volumes on the surrounding roadway network, future traffic conditions were developed. A short-term, 5-year horizon (2011), was evaluated in accordance with the Executive Office of Environmental Affairs/ Executive Office of Transportation (EOEA/EOT) criteria, as well as a mid-term (2014) and a long-term, full build-out horizon (2018). As noted in the Project Description section of this report, the short-term 2011 design horizon was selected both for consistency with standard EOEA/EOT guidelines, and also to coincide with Phase 1 and 1B of the overall Federal Realty Investment Trust (FRIT) development program. This initial analysis phase will consider the proposed IKEA store, residential uses and associated retail uses along with accompanying traffic mitigation measures. The mid-term 2014 design horizon was selected to analyze the anticipated development and associated infrastructure and mitigation just prior to the construction of the planned new MBTA Orange Line station. The associated development will contain additional residential units, a new hotel, and retail space (including a new cinema) all to be constructed before the anticipated construction of the new MBTA station. The final 2018 Build condition considers the full build-out of the site including 1,750,000 sf of office space with associated additional retail space to be built following the construction of the new MBTA Orange Line Station.

These future traffic projections include regional background traffic growth, full occupancy of existing nearby facilities, and planned roadway improvements resulting in the No-Build conditions. Anticipated site-generated traffic volumes were superimposed upon the No-Build traffic volume networks to reflect the year 2011, 2014 and 2018 Build conditions in the study area.

No-Build Conditions

Traffic growth on area roadways is a function of the expected land development, economic activity, and changes in demographics. A frequently used procedure is to identify estimated traffic generated by planned new major developments that would be expected to affect the project study area roadways. An alternative procedure is to estimate an annual percentage increase and apply that increase to study area traffic volumes. To allow for a conservative analysis, historic traffic growth (or ambient

growth) and traffic from specific area projects were included as defined below. Planned roadway improvements were also considered in the No-Build conditions.

No-Build Conditions:

- Regional traffic growth
- IKEA at Assembly Square (approved waterfront site as permitted, Somerville)
- Assembly Square Marketplace (full occupancy; Somerville)
- North Point, Somerville/Cambridge/Boston
- Cambridge Research Park, Cambridge
- Station Landing, Medford
- Wellington Business Center, Medford
- Wellington Place, Medford
- Stop & Shop, Medford
- Telecom City, Medford/Malden/Everett
- Best Buy, Everett

Historic Traffic Growth

Review of MassHighway permanent count station data indicates that in general traffic volumes have been decreasing in the project area. To provide a conservative estimate, however, and to be consistent with other traffic studies in the area a 1.0 percent annual growth rate was applied to the 2006 existing traffic volumes for five-years to determine the short-term, background 2011 No-Build traffic volumes.

However, as traffic is projected into the future beyond the typical five-year horizon (i.e., to the year 2018), the compounding effect of the conservative 1.0 percent growth rate becomes less reasonable. Therefore, for the mid-term and long-term projections an annual background growth estimate of 0.5 percent was assumed for each year subsequent to the short-term, five-year horizon. Thus, a 0.5 percent rate was applied to the 2011 No-Build traffic volumes to determine the mid-term (2014) and the long-term, background 2018 No-Build traffic volumes. This approach is consistent with other long-term projects in the area such as the North Point project in Cambridge, Boston and Somerville.

■

Site-Specific Growth

In addition to accounting for background growth, the traffic associated with other planned and/or approved developments near the site were considered. The following projects were considered:

- **IKEA at Assembly Square**: IKEA has received permits to construct a mixed-use development consisting of approximately 533,000 square feet including a 277,000 IKEA store, approximately 208,000 square feet of office space and 48,000 square feet of retail on the northeastern portion of Assembly Square. Although the current proposed project includes the relocation of the IKEA store to a separate portion of the site, once pending appeals have been resolved, IKEA could conceivably occupy its original site provided it implemented the improvements to which it is committed. Therefore, it is appropriate to include this project in the 2011 No-Build condition along with the proposed transportation improvements associated with it, since in the event the currently proposed project does not proceed IKEA would likely return to its original design and location. The approval of the project included both the approval of the building sizes, locations, and other design elements as well as the traffic that was associated with that project. Since the original approval, VHB has updated the IKEA trip generation database and has revisited the effect of transit on IKEA's traffic. However, for consistency with the original study the approved traffic volumes associated with that project (along with the associated mitigation) have been used for the 2011 No-Build analysis. For the subsequent 2014 No-Build and 2018 No-Build conditions this former IKEA waterfront project is not included, as it is assumed that the IKEA would have instead been constructed at the new location considered in the 2011 Short-Term Build condition.

- **Assembly Square Marketplace (former Assembly Square Mall) full occupancy**: At the time counts were conducted for this study (January 2006), three stores were still unoccupied within the recently redeveloped former Assembly Square Mall: Staples, A.C. Moore, and Sports Authority. These stores consisted of approximately 90,212 square feet. The projected traffic associated with these stores was added to the No-Build traffic volumes. Due to the outcome of a recent court case involving the City of Somerville zoning bylaws, the treatment of traffic generated by this use is complicated. The court's decision in effect dictated that the mall traffic be treated as current project trip generation for the purpose of this assessment. However, the Assembly Square Marketplace is already an existing use generating traffic under present conditions. Accordingly, while the Assembly Square Marketplace traffic is included in the overall project trip generation discussed later in this section, the traffic was not reassigned to the roadway network. Instead, this traffic is already included in both the existing

volumes and subsequent No-Build volumes (after the additional traffic associated with the three tenants noted above).

- **North Point**: The North Point project, similarly to the proposed Assembly Square redevelopment project, consists of several phases. Phases 1A and 1B as well as the Charles E. Smith residential portion were envisioned to be completed in the short-term (within the five-year horizon). These phases consisted of the construction of 1,846 residential units (including the 750 apartments in the Charles E. Smith project) and 1,684,000 square feet of office. The North Point full-build program, envisioned to be completed in 2022, consisted of the construction of a total of 3,540 residential units, 2,140,000 square feet of office, 75,000 square feet of ancillary retail and 90 hotel rooms. These numbers include the North Point, Lechmere, and Charles E. Smith sites. The trips associated with the North Point phase 1 and Charles E. Smith projects were included in the 2011 No-Build traffic volumes, while the trips associated with the project's full-build were included in the 2018 No-Build traffic volumes.

- **Cambridge Research Park**: This project involves the construction of approximately 400 hotel rooms and 157 apartments.

- **Station Landing**: Approximately 100,000 square feet of retail, a 90-room hotel, and 650 housing units are proposed at the southeast corner of the Revere Beach Parkway (Route 16) and Middlesex Fells Parkway (Route 28) adjacent to the Wellington MBTA Station.

- **Wellington Business Center**: This project, proposed between Santilli Circle and Wellington Circle, consists of approximately 385,000 square feet of office space.

- **Wellington Place**: This project proposed in the vicinity of the Wellington Business Center includes 137 residential units.

- **Stop & Shop Expansion**: This project has been recently approved and consists of a small expansion to the existing Stop & Shop plaza in Medford. The expansion includes adding approximately 23,000 square feet of retail and an extra gas pump to the existing 3-pump gas fueling facility on that site.

- **Telecom City**: This project spanning Medford, Malden and Everett, proposed to construct approximately 440,000 square feet of office space.

- **Best Buy**: An approximately 32,000 square foot Best Buy store and small retail, to be located adjacent to Santilli Circle in Everett, is proposed and has been recently approved.

The 2011, 2014 and 2018 No-Build traffic volume networks were developed by applying the appropriate growth rates, adding the traffic generated by the background projects identified above and incorporating previous phases of the Assembly Square mixed-use project envisioned to be completed and occupied by the No-Build conditions analysis year. For example, the 2018 Long-Term Build condition will include both the annual traffic growth expected to occur and the site-specific background traffic, along with the proposed FRIT development expected to occur through the 2014 "Mid-Term" Build Condition. To allow for a direct comparison to the Build conditions analyzed, the 2011, 2014, and 2018 No-Build networks will be presented later in this chapter preceding the subsequent Build networks for those same design years.

■

Future Roadway Conditions

The impact of traffic increases resulting from future background traffic volumes and the proposed project were identified through an operational analysis of the study area roadways. Prior to conducting this analysis, roadway improvements proposed within the boundaries of the study area were considered as discussed below.

The following planned roadway improvement projects will affect future traffic operations within the project study area. It should be noted that most of these improvements are associated with IKEA's existing permitted project. As mentioned previously, in the event the currently proposed project does not proceed IKEA would likely return to its original design. Therefore, IKEA's proposed improvements are expected to be implemented within the five-year build horizon of this study either as part of the currently proposed project or as conditions for IKEA to construct its already approved project. Thus, IKEA proposed improvements were included in the No-Build conditions along with the traffic associated with the permitted IKEA project.

Mystic Avenue, Route 28 (Fellsway/McGrath Highway) and I-93 Interchange

In 1993 MassHighway evaluated potential improvements to the Mystic Avenue, Route 28/I-93 Interchange. This project was expected to enhance access to the Assembly Square site and other surrounding retail developments and improve overall traffic conditions in the area. The design for this project has remained in the early conceptual stages due to funding issues. Accordingly, the interchange redesign is viewed as a long-term improvement project and is not expected to be completed prior to the construction of the proposed project's short-term phase. Improvements to the interchange to accommodate the proposed project have been assessed and recommended later in this study.

Further, as part of IKEA's existing approval, it has committed to implement several improvements at this location aimed primarily at enhancing safety conditions. These improvements include the installation of mast arms and LED signal faces for the southbound Fellsway approach and the northbound Mystic/I-93 northbound off-ramp approach. Additionally, regulatory signage reinforcing the turn restrictions in this area will be installed. These improvements were included in the No-Build conditions.

Mystic Avenue at Lombardi Street/Assembly Square Drive

As part of the IKEA existing approval, the traffic signal at this location will be upgraded and interconnected to the Broadway/Lombardi Street/Mount Vernon Street, Mystic Avenue/New Street, Middlesex Avenue/Foley Street and Assembly Square Drive/Foley Street intersections. Queue detection will be part of the design to manage the queues on Lombardi Street between Broadway and Mystic Avenue.

Broadway at Lombardi Street/Mount Vernon Street

As mentioned above, this intersection will be interconnected to the Mystic Avenue/Lombardi Street/Assembly Square Drive, Mystic Avenue/New Street, Middlesex Avenue/Foley Street and Assembly Square Drive/Foley Street intersections. Queue detection will also be part of the design of this location.

Mystic Avenue at New Road

Anticipated improvements at this location as part of the IKEA currently permitted project include the upgrade of the existing traffic signal including interconnecting it to the Broadway/Lombardi Street/Mount Vernon Street, Mystic Avenue/Lombardi Street/Assembly Square Drive, Middlesex Avenue/Foley Street and Assembly Square Drive/Foley Street intersections.

Foley Street at Middlesex Avenue

As part of the Home Depot project approval, the City of Somerville required that the proponent provide funds to be used to upgrade the existing traffic signal at the Foley Street/Middlesex Avenue intersection. However, since the project was appealed locally, and as a result modified, the improvements at this location were incorporated into the IKEA permitted project's mitigation plan. Thus, the existing traffic signal will be upgraded and interconnected with the Broadway/Lombardi Street/Mount Vernon Street, Mystic Avenue/Lombardi Street/Assembly Square Drive, Mystic Avenue/New Street and Assembly Square Drive/Foley Street intersections.

Foley Street at Assembly Square Drive (Sturtevant Street)

As a condition of its local approval, IKEA has committed to install a new traffic signal at this location, which will be interconnected with the Broadway/Lombardi Street/Mount Vernon Street, Mystic Avenue/Lombardi Street/Assembly Square Drive, Mystic Avenue/New Street and Middlesex Avenue/Foley Street intersections. Additionally, geometric improvements will also be implemented consisting of exclusive northbound and southbound left-turn lanes and an exclusive westbound right-turn lane.

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Public Transportation

In addition to the planned MBTA Orange Line Station at the Assembly Square site, described in detail later in the report, other public transportation improvements are planned for the Somerville area.

Urban Ring Project[2]

The Urban Ring is an initiative of the MBTA to improve the regional transportation system in Boston. The project is planned to connect the existing radial transit lines with a multimodal circumferential transit system to facilitate radial travel. The Urban Ring route extends within a 15-mile corridor from Logan Airport westward through Chelsea, Everett and Medford, southward through Somerville, Cambridge and Brookline, eastward toward UMass Boston and northward back to Logan Airport. The Urban Ring project is proposed to be implemented in three distinct phases. Phase 1 consists of implementation of new and improved crosstown (CT) and express commuter (EC) bus routes. It also includes coordination with local jurisdictions and agencies to preserve rights-of-way along the corridor critical to future Urban Ring service. This phase is currently being implemented and is expected to span a 5-year time horizon. Phase 2, scheduled for the subsequent 5 years, consists of adding bus rapid transit service, adding new and improving existing commuter rail stations, and connecting to rail and bus lines. Finally, Phase 3 involves adding rail transit service in the most heavily traveled portion of the corridor between Assembly Square and Dudley Square. Currently, three Phase 3 alternatives exist; two involving rail and one involving heavy rail.

Currently, no additional service is projected for Assembly Square as part of the Urban Ring Phase 1. However, Final Phase 1 routings and frequencies will be determined by the ongoing MBTA Service Planning process subject to the availability of capital and operating funds.

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[2] Urban Ring Project, MBTA website.

During Phase 2, a Bus Rapid Transit (BRT) line is proposed to service Assembly Square. This BRT line, BRT 1, will be a mix of busway and mixed traffic service starting at Logan Airport and ending at Kendall/MIT. The route will travel through Chelsea, Everett, Somerville and Cambridge with connections to several bus lines and the Blue, Silver, Orange and Red light rail lines.

During Phase 3, the southern portion of this route, between Assembly Square and Kendall will be converted to rail and connected with another rail route ending at Dudley Square.

Beyond Lechmere

A corridor study has been prepared, which evaluated a series of alternative to extend the MBTA Green Line from the Lechemere Station in Cambridge through Somerville to the West Medford Station in Medford. Four alternatives were considered viable in the study. The first alternative provides the extension along the MBTA's Lowell Line with stations in the vicinity of: existing Lechmere Station, Washington Street, Medford Street (Gillman Square), Lowell Street Station, Ball Square, College Avenue, Winthrop Street, and south of High Street. The second alternative would provide Green Line service to Union Square and to West Medford via a two branch operation. One branch would operate similarly to the first option along the Lowell Line while the other branch would operate along the Fitchburg Line from Lechemere with a terminus at Union Square. The stations for the second branch would be located in the vicinity of: existing Lechmere Station and Union Square/Webster Avenue.

The third alternative involves using high-capacity BRT buses that would operate on a two-lane paved roadway within the Lowell Line railroad corridor to West Medford. This alternative has the same alignment and stations as the previous two, the only difference being the usage of BRT buses instead of light rail. Under this alternative, a Green Line segment would operate along the Fitchburg Line from Lechmere with a terminus at Union Square similarly to alternative two. The final alternative would involve providing more frequent commuter rail service and additional stations on the Lowell Line through Somerville to West Medford. One possibility would be to provide this enhanced service between North Station and West Medford, while another would continue the enhanced service to the Anderson RTC in Woburn. The additional stations in this alternative would include Medford Street, Lowell Street, Winthrop Street and south of High Street. Finally, a Transportation System Management (TSM) alternative was also evaluated, which would include increasing headways on existing bus routes and the addition of one bust route in Somerville (Medford Hillside Circulator).

While this project would increase the public transportation availability in the City of Somerville, it would not have a direct impact on Assembly Square as these routes are located on a different sector of the City.

Build Conditions – Trip Distribution/Trip Generation

Build traffic volumes were determined by estimating site-generated traffic volumes and distributing these volumes over the study area roadways.

Trip Distribution and Assignment

The directional distribution of traffic approaching and departing the development is a function of several variables. These include the population densities, shopping opportunities, competing uses, existing travel patterns, and the efficiency of the roadways leading to the site.

Due to the varying trip characteristics of the redevelopment uses – residential, office, retail and IKEA – each use is expected to experience a different distribution pattern. Thus, regional trip distribution percentages were calculated separately for each of the project's uses. The more localized trip distribution (i.e., within each study intersection) was developed based on the site location of the uses.

The residential and office trip distribution patterns were determined using journey-to-work census data derived from the 2000 US Census for the City of Somerville. The trip distribution for the retail component was developed based on a gravity model utilizing the Census data for communities included in the market trade area. Based on the distribution of population within the projected market trade area, arrival and departure patterns for project-related traffic were estimated and adjusted, if appropriate, based on known local factors such as locations of competing opportunities. The assignment of site-generated traffic to specific travel routes was based on observed traffic flow conditions on available routes, and the assumption that most motorists will seek the fastest and most direct routes to and from the site.

The distribution for IKEA customers is expected to be substantially different from that of other retail uses in the area. Due to the limited number of IKEA stores in the New England market, this store is expected to draw more customers regionally and fewer locally. Further, given the opening of the new IKEA store in Stoughton, Massachusetts, the Somerville store's draw will be more oriented to the north as Stoughton serves the southern communities. The IKEA trip distribution patterns were derived based on market research information, the Census data and existing roadway infrastructure.

Table 4 summarizes the resulting trip distribution patterns for the project. The individual trip distribution patterns for the IKEA, retail, residential and office uses are shown in Figures 8 through 11, respectively.

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Figure 8
Ikea Trip Distribution

0 200 400 Feet

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Figure 9
Retail Trip Distribution

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Figure 10
Residential Trip Distribution

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Figure 11
Office Trip Distribution

Table 4
Vehicle Trip Distribution Summary

		Percent of Total			
Route	Direction	Residential	Office	Retail	IKEA
I-93	north	11%	28%	3%	51%
I-93	south	29%	25%	1%	31%
Route 28	northwest	5%	12%	15%	3%
Route 28	southeast	36%	19%	26%	10%
Broadway	northwest	11%	8%	26%	3%
Mystic Avenue	north	3%	4%	10%	2%
Mystic Avenue	south	3%	2%	8%	--
Local Roadways	--	2%	2%	11%	--
Total	--	100%	100%	100%	100%

■

Trip Generation

To estimate the volume of traffic generated by the proposed redevelopment, VHB conducted an extensive evaluation of potential site trip generation for the proposed project. The rate at which any development generates traffic is dependent upon a number of factors such as size, location and concentration of surrounding development. To determine the expected volume of traffic associated with the redevelopment, trip generation rates published by the Institute of Transportation Engineers [ITE] *Trip Generation*[3] were utilized.

Estimating the traffic associated with the proposed mixed-use development is a complicated exercise due to the variety of uses involved, expected changes in transit service in the area, and other factors. Accordingly, trip generation for each of the major site components and project's phases – the existing Assembly Square Marketplace, the proposed IKEA, and the primary Assembly Square Development phases – are discussed below in separate sections. The effect of shared- and pass-by trips, transit amenities, pedestrian/bicycle travel, and other factors are also noted and incorporated into the overall analysis where appropriate.

As noted earlier, traffic associated with the Assembly Square Marketplace is considered as trip generation associated with the current Assembly Square

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[3] Trip Generation; Seventh Edition; Institute of Transportation Engineers; Washington, D.C.; 2003.

Development project for which this study was prepared. However, the trips generated by this existing use did not need to be assigned to the roadway system in the analysis as the traffic is already accounted for in the existing conditions traffic counts conducted in January 2006. As discussed in the No-Build conditions section, traffic associated with the three stores that were not occupied at the time of the counts was subsequently estimated and added to the roadway system under the No-Build condition.

While the ITE database contains several retail uses, it does not include any uses that accurately reflect the traffic characteristics of an IKEA store. Therefore, the trip generation associated with the IKEA use was determined through the use of actual traffic counts observed at existing IKEA stores, as discussed later in this section.

The following sections summarize the anticipated trip generation for each of the major project components as described above as they occur during each subsequent phase of the project development.

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2011 "Short-Term" Build Condition Trip Generation

Under the 2011 "Short-Term" Build condition scenario assumed for this assessment, the following development is included:

- **Assembly Square Marketplace (full occupancy)**
- **310,000 sf IKEA store**
- **300 apartment units**
- **736 condominium units**
- **192,795 sf of retail space**

As noted earlier, the existing 328,806 sf Assembly Square Marketplace is in fact already constructed and operating. This retail space and traffic associated with its full occupancy (three stores were unoccupied under the existing conditions) was accounted for under the 2011 No-Build scenario. Regardless, the traffic associated with the former mall is considered as part of the overall FRIT development for the purpose of this assessment in keeping with a recent ruling regarding litigation involving the City of Somerville zoning ordinance. Accordingly, while this traffic is already in place on the roadway networks under the 2011 No-Build condition (and subsequent No-Build conditions) it is considered as project-related traffic for this assessment.

The projected traffic associated with the Assembly Square Marketplace, the IKEA store, residential units and associated retail space was estimated as described in the following sections.

Assembly Square Marketplace Trip Generation

The Assembly Square Marketplace (former Assembly Square Mall redevelopment) contains approximately 328,806 sf of retail building space. During the January 2006 traffic data collection for this study, Staples, A.C. Moore, and Sports Authority had not yet been occupied. The projected traffic associated with this 90,212 sf of retail space was estimated and added to the No-Build traffic volumes as discussed earlier. Due to the current configuration of the Assembly Square Marketplace its access points also function as access and egress routes to other uses within the Assembly Square district. Because of this, it is not possible to accurately isolate the Assembly Square Marketplace traffic volumes for the purpose of identifying trip generation. Instead, the trips estimated to be generated by the Assembly Square Marketplace at full occupancy were calculated based on the rates contained in the Seventh Edition of *Trip Generation*[4] published by the Institute of Transportation Engineers (ITE). Traffic volumes generated by retail uses in shopping centers generally follow well-established patterns with respect to magnitude, duration, and temporal distribution throughout the day. The data collected by ITE for shopping centers (land use code 820) are based on several studies of retail uses of this type. Accordingly, traffic associated with the Assembly Square Marketplace was estimated using ITE LUC 820 for the purpose of this study as shown below in Table 5.

[4] Trip Generation, 7th Edition, Institute of Transportation Engineers, Washington, D.C. (2003).

Table 5
Assembly Square Marketplace Trip Generation

Time Period	Vehicle Trips[a]
Weekday	
Daily	14,720
Morning Peak Hour	
Enter	195
Exit	125
Total	320
Evening Peak Hour	
Enter	660
Exit	715
Total	1,375
Saturday	
Daily	19,560
Midday Peak Hour	
Enter	975
Exit	900
Total	1,875

a. Based on ITE Land Use Code 820 (Shopping Center) for 328,806 sf.

The trip generation estimated to be currently generated by the Assembly Square Marketplace is summarized above in Table 5. As with most retail developments, not all of the traffic attracted to this retail space will be new traffic on study area roadways. A portion of the vehicle-trips will be drawn from the existing traffic streams passing the site in the form of pass-by traffic, or from roadways in the vicinity of the site in the form of diverted-link traffic. Pass-by trips are made as intermediate stops while a vehicle passes directly by the site en-route from an origin to a primary trip destination and do not require any route diversion to access the site. Diverted-link trips are similar to pass-by trips in that they are attracted to the project site from existing area traffic volumes. However, diverted-link trips require a diversion from the roadway that they are traveling on to another roadway to gain direct access to the site. Both the pass-by and diverted link traffic is already inherent included in the traffic being generated by the site on the roadway system. For the retail space occupied after the initial counts were conducted, a 25-percent pass-by rate was utilized in this study in accordance with MEPA and MassHighway guidelines.

Based on current observations of bus ridership at the Assembly Square Marketplace, combined with MBTA ridership information, VHB estimates that current transit use at the mall is likely only around one-percent of the total potential retail traffic. This level of transit usage will likely increase with the planned future MBTA station, but will likely remain at this level prior to the construction of a new station as the transit

service will be primarily limited to bus use. Detailed trip generation calculation sheets are provided in the appendix to this report.

IKEA Trip Generation

A number of IKEA stores have opened in the United States since 2002 when the IKEA project at Assembly Square was proposed, including a Massachusetts store located in Stoughton. Therefore, the IKEA trip generation has been reevaluated to reflect these changed conditions.

Stoughton, MA – IKEA

Recent counts conducted at the IKEA store in Stoughton, Massachusetts, were also reviewed for comparison purposes. The Stoughton facility has been the subject of considerable attention as it was the first IKEA store to open in Massachusetts as of November 2005. The proposed Somerville facility will represent a second store in this market, and it is expected that some of the traffic currently visiting the Stoughton facility from points to the north could now instead be shifted to the Somerville site. As the Stoughton store is now servicing a market intended for two stores, its inclusion in the database is not appropriate. However, the observed counts at that site have been included for general reference purposes and are shown in Table 6.

Table 6
Stoughton IKEA Trip Generation

	Observed Stoughton IKEA
Weekday	
Daily (vpd)	4,670
Morning Peak (vph)	
Enter	n/a
Exit	n/a
Total	n/a
Evening Peak (vph)	
Enter	220
Exit	205
Total	425
Saturday	
Daily (vpd)	4,330
Midday Peak (vph)	
Enter	430
Exit	420
Total	850

Source: IKEA Stoughton Traffic Monitoring Report, Coler & Colantonio, Inc., Spring 2006.

IKEA Trip Generation Database

As part of this study, counts were obtained at seven locations where trip generation counts could accurately be conducted. An adequate location for the purpose of determining trip estimates required that the store be freestanding, i.e.; the store is not located within a shopping mall environment that would prevent IKEA traffic from being isolated for counting purposes. The following locations were determined to be the most appropriate as they presented similarities to the proposed IKEA in terms of size, market, and/or setting:

- Shaumburg, Illinois
- Bollingbrook, Illinois
- Atlanta, Georgia
- New Haven, Connecticut
- Emeryville, California
- Renton, Washington
- Woodbridge, Virginia

Table 7 summarizes the observed trip generation at the seven IKEA stores included in the updated IKEA trip generation database.

Table 7
Observed IKEA Trip Generation

	Shaumburg, Illinois (450,556-sf)[a]	Bollingbrook, Illinois (310,000 sf) [a]	Atlanta, Georgia (366,081 st) [a]	New Haven, Connecticut (310,276 sf) [a]	Emeryville, California (274,479 sf) [b]	Renton, Washington (350,000 sf) [b]	Woodbridge, Virginia (301,389 sf)
Weekday							
Daily (vpd)	7,310	4,070	7,800	6,080	7,460	6,220	3,620
Morning Peak (vph)							
Enter	45	40	165	95	75	285	150
Exit	25	15	135	130	55	65	55
Total	70	55	300	225	130	350	205
Evening Peak (vph)							
Enter	190	155	270	175	425	395	195
Exit	265	135	240	225	240	255	130
Total	455	290	510	400	665	650	325
Saturday							
Daily (vpd)	9,810	5,340	10,500	6,680	14,980	12,050	13,030
Midday Peak (vph)							
Enter	440	260	520	265	845	735	765
Exit	370	185	530	235	680	525	590
Total	810	445	1,050	500	1,525	1,260	1,355

n/a Data Not Available.
a. Source: Counts conducted week of June 12, 2006.
b. Source: IKEA Trip Generation Study, Vollmer, March 13, 2003.

It is intuitive that the development of trip generation rates becomes more accurate as the number of available data points increases. The Institute of Transportation Engineers (ITE) has a recommended practice for how to develop a local trip generation rate or equation in the absence of an appropriate ITE land use code. ITE's "Trip Generation Handbook"[5] recommends that "at least three sites (and preferably at least five)" (page 20) be used to establish a trip generation rate. The IKEA empirical data conforms to these requirements having seven data points for the peak hours and the daily volumes. Consequently, based on ITE recommendations and the availability and characteristics of US IKEA stores, the IKEA empirical data collected will provide the most adequate trip generation rate for an IKEA store. The following sections provide detailed information regarding the technical procedures used to estimate IKEA trip generation.

ITE presents three methodologies to estimate trips at proposed developments: graphical plot, weighted average trip rate and regression equations. Since the graphical method requires enough data points to allow for an accurate relationship

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[5] Institute of Transportation Engineers, Trip Generation Handbook, Washington, D.C., March 2001.

between the two variables, this method would not be the best suited approach for the IKEA study. Thus, only the two latter methodologies were investigated further.

Weighted Average Trip Rate

The weighted average trip rate has been the traditional method of forecasting trips. For this methodology to be valid, however, at least three data points are needed with a computed standard deviation that is no more than 110 percent of the weighted average rate. Based on the available data, the following rates were derived from the volumes observed for the IKEA stores:

Table 8
Observed IKEA Trip Generation Rates

	Shaumburg	Bollingbrook	Atlanta	New Haven	Emeryville	Renton	Woodbridge	Weighted Trip Rate	Standard Deviation
Weekday									
Daily	16.98	13.13	21.31	19.60	27.18	17.77	12.01	18.17	5.13
Morning Peak									
Enter	0.10	0.13	0.45	0.31	0.27	0.81	0.50	0.36	0.25
Exit	0.06	0.05	0.37	0.42	0.20	0.19	0.18	0.20	0.14
Total	0.16	0.18	0.82	0.73	0.47	1.00	0.68	0.57	0.32
Evening Peak									
Enter	0.44	0.50	0.74	0.56	1.55	1.13	0.65	0.77	0.40
Exit	0.62	0.44	0.66	0.73	0.87	0.73	0.43	0.64	0.16
Total	1.06	0.94	1.39	1.29	2.42	1.86	1.08	1.41	0.53
Saturday									
Daily	22.78	17.23	28.68	21.53	54.58	34.43	43.23	30.90	13.32
Midday Peak									
Enter	1.02	0.84	1.42	0.85	3.08	2.10	2.54	1.63	0.89
Exit	0.86	0.60	1.45	0.76	2.48	1.50	1.96	1.33	0.69
Total	1.88	1.44	2.87	1.61	5.56	3.60	4.50	2.96	1.57

As shown in Table 8, the standard deviation ranges from 28 and 56 percent of the weighted average rate. These values meet the ITE requirements of having the standard deviation be no more than 110 percent of the weighted average rate. Accordingly, use of this methodology is acceptable, though VHB also reviewed the possibility of developing regression equations to calculate trip generation.

Regression Analysis

The regression analysis methodology involves developing an equation that defines the line that "fits best" through the data points. The regression equation does not need to provide a linear relationship between the variables. Based on the plots resulting of the available data, three potential relationships were investigated: a linear relationship between trips and size, a logarithmic relationship between trips and size and a semi-logarithmic relationship between trips and size.

R^2, the coefficient of determination, represents the percent of the variance between the actual observed value and the average value that is explained by the equation. In other words, an R^2 of 0.51 means that 51 percent of the variance between the observed number of trips for a given store and the number of trips predicted using the average rate is captured by using the equation. The closer R^2 is to 1.0, the better the relationship between the number of trips and the size of the independent variable.

ITE indicates that acceptable use of a regression equation requires at least four data points with a computed R^2 of at least 0.75. None of the regression equations for the IKEA store trip generation meet these requirements; therefore, it was concluded that this methodology was not appropriate for this study.

IKEA Trip Generation

Based on the recommended standard practice, VHB determined that the most appropriate trip generation methodology to apply to the IKEA store was the weighted average rate. The estimated IKEA trip generation associated with the calculated rates is shown in Table 9. As noted earlier, the counts conducted at the Stoughton IKEA site, which were presented earlier in this section, were not included in the database used to develop the IKEA trip generation rates used for this study.

Table 9
IKEA Building Trip Generation

	Estimated Somerville IKEA
Weekday	
Daily (vpd)	5,630
Morning Peak (vph)	
Enter	115
Exit	65
Total	180
Evening Peak (vph)	
Enter	240
Exit	195
Total	435
Saturday	
Daily (vpd)	9,580
Midday Peak (vph)	
Enter	510
Exit	410
Total	920

a. Based on weighted average rate applied to proposed IKEA 310,000 square foot build area.

As shown in Table 9, basing trip generation on the weighted average trip rate yields approximately 5,630 trips on a typical weekday, with 435 of these trips occurring during the evening peak hour. On a Saturday, IKEA is expected to generate approximately 9,580 trips with 920 trips occurring during the midday peak hour. It should be noted that the weighted average trip rates and resulting trip generation figures are higher than those observed at the Stoughton IKEA store as presented earlier in this section, even though the Somerville store is a smaller store and would represent a second store in the area. Therefore, it is likely that the proposed Somerville IKEA store will generate fewer trips than those used in this study. Regardless, to provide for a conservative analysis VHB used the trip generation shown for the proposed Somerville site as shown in Table 9.

Mixed-Use Trip Generation

The number of vehicle-trips estimated to be generated by the proposed project was determined by applying trip generation rates published by ITE. The following ITE land use codes were determined to be the most appropriate to apply to the proposed development:

- LUC 220 – apartments
- LUC 230 – condominium/townhouse
- LUC 310 – hotel
- LUC 710 – office

- LUC 435 – cinema
- LUC 820 – shopping center

While some of the uses listed above – hotel, cinema and office – will not be constructed until subsequent phases, the traffic associated with those uses will be calculated using the ITE-based methodology noted above. Please note that the estimated trips associated with the mid-term and full-build phases are cumulative and represent the total number of trips associated with the project to that moment; the incremental impacts of each phase can be determined by comparing its trip generation with the one associated with the prior phase.

2011 "Short Term" Build Condition Assembly Square Mixed-Use development Raw Trip Generation

The anticipated project trip generation associated with the Assembly Square mixed-use development for the 2011 Short-Term Build Condition is summarized below in Table 10. The volumes shown are the unadjusted vehicular trip generation estimates, which do not account for internal trips sharing, reduced vehicular traffic resulting from bicyclists/pedestrians, and transit usage. The effect of these factors on the trip generation figures shown below will be discussed in detail later in this section. [In the subsequent tables, the effect of these factors on both the Assembly Square mixed-use development *and IKEA* will be quantified.] Also, while all of the development components are listed, only those elements planned to be developed within this initial analysis phase are accompanied by trip generation estimates.

Table 10
Short-term (2011) Mixed-Use Trip Generation*

	Total Trips						
Use	Apartments	Condos	Hotel	Office	Cinema	Retail	Total
Size	300 units	736 units	0 rooms	0 SF	0 screens	192,795 sf	
Weekday							
Daily (vpd)	1,960	3,500	0	0	0	5,150	10,610
Morning Peak (vph)							
Enter	30	45	0	0	0	60	135
Exit	120	210	0	0	0	40	370
Total	150	255	0	0	0	100	505
Evening Peak (vph)							
Enter	120	210	0	0	0	235	565
Exit	65	100	0	0	0	255	420
Total	185	310	0	0	0	490	985
Saturday							
Daily (vpd)	1,920	3,090	0	0	0	6,600	11,610
Midday Peak (vph)							
Enter	80	140	0	0	0	340	560
Exit	80	120	0	0	0	315	515
Total	160	260	0	0	0	655	1,075

* ITE Trip Generation, 7th Edition.
vpd vehicles per day
vph vehicles per hour

As shown in Table 10, the maximum vehicular trip generation expected to be associated with the mixed-use component of the 2011 Short-Term Build Condition is 10,610 vehicle trips on a typical weekday, with 505 and 985 vehicle trips expected to occur during the respective morning and evening peak hours. Saturday trip generation would be expected to be slightly higher, with 11,610 vehicles generated on a daily basis, with 1,075 trips occurring during the midday peak hour.

2011 "Short-Term" Build Condition – Cumulative Raw Trip Generation

As summarized in the previous sections, VHB estimated the raw trip generation associated with the Assembly Square Marketplace, proposed IKEA store, and proposed mixed-use development without taking credit for internal trip sharing, transit use, pass-by traffic, and pedestrian/bicycle traffic. The total raw trip generation for these uses is summarized in Table 11. Again, the estimates shown above are only shown for starting baseline purposes, and do not reflect internal shared trips, pass-by trips, or the effects of pedestrians, bicyclists, or transit use. These factors are reflected in Table 16 later in this section.

Table 11
Short-term (2011) Cumulative Raw Trip Generation*

Use	Assembly Square Marketplace	Mixed-Use Development				IKEA	Total with IKEA
		Apartments	Condos	Retail	SubTotal		
Size	328,806 sf	300 units	736 units	192,795 sf		310,000 sf	
Weekday							
Daily (vpd)	14,720	1,960	3,500	5,150	10,610	5,630	16,240
Morning Peak (vph)							
Enter	195	30	45	60	135	115	250
Exit	125	120	210	40	370	65	435
Total	320	150	255	100	505	180	685
Evening Peak (vph)							
Enter	660	120	210	235	565	240	805
Exit	715	65	100	255	420	195	615
Total	1,375	185	310	490	985	435	1,420
Saturday							
Daily (vpd)	19,560	1,920	3,090	6,600	11,610	9,580	21,190
Midday Peak (vph)							
Enter	975	80	140	340	560	510	1070
Exit	900	80	120	315	515	410	925
Total	1,875	160	260	655	1,075	920	1,995

* ITE Trip Generation, 7th Edition.
vpd vehicles per day
vph vehicles per hour

As shown in Table 11, the combination of the IKEA store and Assembly Square mixed-use development would generate 16,240 vehicle trips on a typical weekday, with 685 and 1,420 of these trips occurring during the respective morning and evening peak hours. The combined Saturday trip generation would be expected to be slightly higher, with 21,190 vehicles generated on a daily basis, with 1,995 trips occurring during the midday peak hour. This is in addition to the Assembly Square Marketplace traffic that is also considered as part of the 2011 Short-Term Build condition. As that traffic is already included in the existing and No-Build networks it is listed separately in the tables, as the effects of pass-by traffic, transit use, etc. are inherent within the observed volumes.

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2014 "Mid-Term" Build Condition Trip Generation

Under the 2014 "Short-Term" Build condition scenario for this assessment, the following development was assumed to occur following the 2011 Build condition:

- **390 apartment units (in addition to 300 constructed under 2011 "Short-Term" Build condition)**
- **674 condominium units (in addition to 736 constructed under 2011 "Short-Term" Build condition)**
- **238,165 sf of retail space (in addition to 192,795 sf of retail space constructed under 2011 "Short-Term" Build condition)**
- **200-room hotel**
- **14-screen/62,000 sf movie cinema**

The projected traffic associated with the additional residential units, retail space and the new hotel and cinema was estimated as described in the following sections.

2014 "Mid-Term" Build Condition Raw Assembly Square Mixed-Use development Trip Generation

The anticipated project trip generation associated with the mixed-use development for the 2014 Mid-Term Build Condition is summarized below in Table 12. The trip generation for the residential and retail uses was calculated in the same manner as that used for the 2011 Short-Term Build condition. The traffic associated with the proposed hotel was calculated using the ITE Land Use Code (LUC) for a standard hotel (ITE LUC 310), the cinema was calculated using ITE LUC 435 and the office space was calculate using ITE data for general office space (ITE LUC 710). The volumes shown are the unadjusted vehicular trip generation estimates, which do not account for internal trips sharing, reduced vehicular traffic resulting from bicyclists/pedestrians, and transit usage. The effect of these factors on the trip generation figures shown below will be discussed in detail later in this section. [In the subsequent tables, the effect of these factors on both the Assembly Square mixed-use development *and IKEA* will be quantified.] Further, Table 12 reflects the *cumulative* trip generation associated with the project to this point. The *incremental* impact of this phase can be determined by comparing its trip generation with that of the short-term phase.

Table 12
Mid-term (2014) Cumulative Mixed-Use Trip Generation*

	Total Trips						
Use	Apartments	Condos	Hotel	Office	Cinema	Retail	Total
Size	690 units	1,410 units	200 rooms	0 SF	14 screens	430,960 SF	
Weekday							
Daily (vpd)	4,300	6,090	1,630	0	4,100	10,650	26,770
Morning Peak (vph)							
Enter	70	75	65	0	0	130	340
Exit	275	355	45	0	0	80	755
Total	345	430	110	0	0	210	1,095
Evening Peak (vph)							
Enter	260	350	65	0	190	490	1,355
Exit	140	175	55	0	130	525	1,025
Total	400	525	120	0	320	1,015	2,380
Saturday							
Daily (vpd)	4,410	5,530	1,640	0	4,500	13,590	29,670
Midday Peak (vph)							
Enter	180	245	80	0	200	705	1,410
Exit	180	210	65	0	80	650	1,185
Total	360	455	145	0	280	1,355	2,595

* ITE Trip Generation, 7th Edition.
vpd vehicles per day
vph vehicles per hour

As shown in Table 12, the maximum vehicular trip generation expected to be associated with mixed-use development under the 2014 Mid-Term Build Condition is 26,770 vehicle trips on a typical weekday, with 1,095 and 2,380 vehicle trips expected to occur during the respective morning and evening peak hours. Saturday trip generation would be expected to be slightly higher, with 29,670 vehicles generated on a daily basis, with 2,595 trips occurring during the midday peak hour. As with the trip generation figures shown for the 2011 Short-Term Build Condition, these estimates do not reflect internal shared trips, pass-by trips, or the effects of pedestrians, bicyclists, or transit use. These factors are reflected in Table 17 later in this section.

2014 "Mid-Term" Build Condition – Cumulative Raw Trip Generation

As summarized in the previous section, VHB estimated the raw trip generation associated with additional residential development, retail space, along with the new proposed hotel and movie cinema without adjustment for non-automobile travel (transit, pedestrian/bicycle, etc.). The total raw cumulative trip generation for these uses, along with that for the Assembly Square Marketplace and IKEA, is summarized in Table 13, including traffic that was estimated to have occurred in the first analysis phase.

Table 13
Mid-term (2014) Cumulative Raw Trip Generation*

		Mixed-Use Development							
Use	Assembly Square Marketplace	Apartments	Condos	Retail	Hotel	Cinema	SubTotal	IKEA	Total with IKEA
Size	328,806 sf	690 units	1,410 units	430,960 sf	200 rooms	14 screens		310,000 sf	
Weekday									
Daily (vpd)	14,720	4,300	6,090	10,650	1,630	4,100	26,770	5,630	32,400
Morning Peak (vph)									
Enter	195	70	75	130	65	0	340	115	455
Exit	125	275	355	80	45	0	755	65	820
Total	320	345	430	210	110	0	1,095	180	1,275
Evening Peak (vph)									
Enter	660	260	350	490	65	190	1,355	240	1,595
Exit	715	140	175	525	55	130	1,025	195	1,220
Total	1,375	400	525	1,015	120	320	2,380	435	2,815
Saturday									
Daily (vpd)	19,560	4,410	5,530	13,590	1,640	4,500	29,670	9,580	39,250
Midday Peak (vph)									
Enter	975	180	245	705	80	200	1,410	510	1,920
Exit	900	180	210	650	65	80	1,185	410	1,595
Total	1,875	360	455	1,355	145	280	2,595	920	3,515

* ITE Trip Generation, 7th Edition.
vpd vehicles per day
vph vehicles per hour

As shown in Table 13, with the additional mixed-use traffic summarized in Table 12, the combination of the IKEA store and Assembly Square mixed-use development would generate 32,400 vehicle trips on a typical weekday, with 1,275 and 2,815 of these trips occurring during the respective morning and evening peak hours. The combined Saturday trip generation would be expected to be slightly higher, with

39,250 vehicles generated on a daily basis, with 3,515 trips occurring during the midday peak hour. This is in addition to the Assembly Square Marketplace traffic shown in the left column. As that traffic is already included in the existing and No-Build networks it is listed separately in the tables, as the effects of pass-by traffic, transit use, etc. are inherent within the observed volumes.

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2018 "Long-Term" Build Condition Trip Generation

Under the 2018 "Long-Term" Build condition scenario for this assessment, the following development was assumed to occur following the 2014 Build condition:

- **1,750,000 sf of office space**
- **19,040 sf of retail space (in addition to 238,165 sf of retail space constructed under 2014 "Mid-Term" Build condition)**

The projected traffic associated with the new office space and additional retail space was estimated as described in the following sections.

2018 "Long-Term" Build Condition Assembly Square Mixed-Use development Raw Trip Generation

The anticipated project trip generation associated with the mixed-use development for the 2018 Long-Term Build Condition is summarized below in Table 14. The volumes shown are the unadjusted vehicular trip generation estimates, which do not account for internal trips sharing, reduced vehicular traffic resulting from bicyclists/pedestrians, and transit usage. The effect of these factors on the trip generation figures shown below will be discussed in detail later in this section. [In the subsequent tables, the effect of these factors on both the Assembly Square mixed-use development *and IKEA* will be quantified.] Further, Table 14 reflects the *cumulative* trip generation associated with the project to this point. The *incremental* impact of this phase can be determined by comparing its trip generation with that of the mid-term phase.

Table 14
Long-term (2018) Cumulative Mixed-Use Trip Generation*

	Total Trips						
Use	Apartments	Condos	Hotel	Office	Cinema	Retail	Total
Size	690 units	1,410 units	200 rooms	1,750,000 SF	14 screens	450,000 SF	
Weekday							
Daily (vpd)	4,300	6,090	1,630	12,090	4,100	11,060	39,270
Morning Peak (vph)							
Enter	70	75	65	1,630	0	130	1,970
Exit	275	355	45	220	0	85	980
Total	345	430	110	1,850	0	215	2,950
Evening Peak (vph)							
Enter	260	350	65	350	190	505	1,720
Exit	140	175	55	1,690	130	550	2,740
Total	400	525	120	2,040	320	1,055	4,460
Saturday							
Daily (vpd)	4,410	5,530	1,640	3,760	4,500	14,120	33,960
Midday Peak (vph)							
Enter	180	245	80	205	200	730	1,640
Exit	180	210	65	170	80	680	1,385
Total	360	455	145	375	280	1,410	3,025

* ITE Trip Generation, 7th Edition.
vpd vehicles per day
vph vehicles per hour

As shown in Table 14, the maximum vehicular trip generation expected to be associated with the mixed-use component of the 2018 Long-Term Build Condition is 39,270 vehicle trips on a typical weekday, with 2,950 and 4,460 vehicle trips expected to occur during the respective morning and evening peak hours. Saturday trip generation would be expected to be slightly higher, with 33,960 vehicles generated on a daily basis, with 3,025 trips occurring during the midday peak hour. As with the prior trip generation tables in this section, these figures do not reflect internal shared trips, pass-by trips, or the effects of pedestrians, bicyclists, or transit use. These factors are reflected in Table 18 later in this section.

2018 "Long-Term" Build Condition – Cumulative Raw Trip Generation

As summarized in the previous section, VHB estimated the raw trip generation associated with new 1,750,000 sf of office space and additional associated retail space without adjustment for non-automobile travel (transit, pedestrian/bicycle, etc.). The total raw cumulative trip generation for these uses is summarized in Table 15, including traffic that was estimated to have occurred in the prior two analysis phases.

Table 15
Long-term (2018) Cumulative Raw Trip Generation*

		Mixed-Use Development								
Use	Assembly Square Marketplace	Apartments	Condos	Retail	Hotel	Cinema	Office	SubTotal	IKEA	Total with IKEA
Size	328,806 sf	690 units	1,410 units	450 ksf	200 rooms	14 screens	1.75 mil		310 ksf	
Weekday										
Daily (vpd)	14,720	4,300	6,090	11,060	1,630	4,100	12,090	39,270	5,630	44,900
Morning Peak (vph)										
Enter	195	70	75	130	65	0	1,630	1,970	115	2,085
Exit	125	275	355	85	45	0	220	980	65	1,045
Total	320	345	430	215	110	0	1,850	2,950	180	3,130
Evening Peak (vph)										
Enter	660	260	350	505	65	190	350	1,720	240	1,960
Exit	715	140	175	550	55	130	1,690	2,740	195	2,935
Total	1,375	400	525	1,055	120	320	2,040	4,460	435	4,895
Saturday										
Daily (vpd)	19,560	4,410	5,530	14,120	1,640	4,500	3,760	33,960	9,580	43,540
Midday Peak (vph)										
Enter	975	180	245	730	80	200	205	1,640	510	2,150
Exit	900	180	210	680	65	80	170	1,385	410	1,795
Total	1,875	360	455	1,410	145	280	375	3,025	920	3,945

* ITE Trip Generation, 7th Edition.
vpd vehicles per day
vph vehicles per hour

As shown in Table 15, with the office-generated traffic, and additional retail traffic summarized in Table 14, the combination of the IKEA store and Assembly Square mixed-use development would generate 44,900 vehicle trips on a typical weekday, with 3,130 and 4,895 of these trips occurring during the respective morning and evening peak hours. The combined Saturday trip generation would be expected to be slightly higher, with 43,540 vehicles generated on a daily basis, with 3,945 trips occurring during the midday peak hour. This is in addition to the Assembly Square Marketplace traffic shown in the left column. As that traffic is already included in the existing and No-Build networks it is listed separately in the tables, as the effects of pass-by traffic, transit use, etc. are inherent within the observed volumes.

The total volumes shown in the table presented above, along with the prior tables, are not intended to represent the actual volume of vehicular traffic that will be traveling on the study area roadways. Instead, the trip generation figures shown are only presented as a baseline condition as to what could be expected without any

consideration being given to pass-by traffic, internal trips sharing, bicycle/pedestrian travel, and transit use. The following sections quantify the effects of each of these factors.

Shared Vehicle-Trips

Given the mixed-use nature of the project, there will be some degree of shared business between the residential, hotel, office and retail components of the project as well as some shared-trips between the proposed project and the Assembly Square Marketplace. While these shared trips represent new traffic to the individual uses, they would not show up as new vehicle trips on the surrounding roadway network aside from the internal site driveways. Based on recommended ITE guidelines, it was determined that up to a 15 percent internal capture rate could occur between the uses.

Pass-by/ Diverted-Link Vehicle-Trips

In addition to the shared trips expected to occur within the site and between the site and the Assembly Square Marketplace, not all of the remaining trips generated by the retail (including IKEA) components of the project will be new traffic that is added to the study area roadways. Retail uses typically attract a significant percentage of their traffic from the traffic streams passing the site, particularly during peak periods. These trips, which are considered pass-by or diverted-link trips, are already on the roadway system traveling to and from locations other than the site (such as home, work or other shopping destinations). In Massachusetts, a pass-by rate of 25% is considered the standard in accordance with EOEA/EOT guidelines. Therefore, a 25% pass-by/diverted-link rate was utilized to determine the new retail trips to the site.

A pass-by survey was conducted at the IKEA located in the City of Industry, California, to determine pass-by and diverted-link rates associated with this use. The survey revealed that, over a three-hour period on Saturdays, 58 percent of the customers visiting IKEA were on their way to or from some other destination and were not making a trip exclusively to visit IKEA. The survey also indicated that, of this 58 percent half (29 percent) visited the site as pass-by trips and the other half were making a diverted-link trip. Therefore, a 25 percent pass-by rate for IKEA is justified by the results of this survey. Nevertheless, given that IKEA's presence in the northeast is still limited and to remain consistent with previous efforts methodologies, a smaller pass-by rate was derived for the IKEA traffic. It was assumed that only 10 percent of the regional traffic from Route I-93 to the site would result from pass-by trips; this represents approximately 8 percent of the total IKEA trips (10% of the 80% overall IKEA traffic via I-93 – see Trip Distribution section). For the 20 percent of the traffic arriving locally the standard 25 percent is considered appropriate resulting in approximately 5 percent of the total IKEA trips. Combining the pass-by rate from both the regional and local systems yields an overall pass-by

rate of approximately 13 percent. Accordingly, the 13 percent pass-by rate was used for IKEA traffic (versus 15 percent used on previous IKEA permitting studies).

Transit Trips

As previously mentioned, an MBTA Orange Line station is envisioned to be constructed at the Assembly Square site around the year 2015. This station is necessary to accommodate all the proposed development on the site. A detailed analysis was conducted to estimate the probable mode splits for the project described in detail below. The information gathered includes empirical data from the U.S. Census Transportation Planning Package, research on transit-oriented development, and sample mode shares from similar large projects. The accumulated data was used to develop estimated public transit mode share for the Assembly Square site both before and after a new Orange Line Station is constructed.

2000 Census transit mode shares were analyzed for home-based and work-based trips for a range of metropolitan Boston locations including Wellington, Alewife, the City of Medford, Kendall Square and Lechmere as well as Assembly Square. Existing mode shares for Assembly Square and these other areas were determined to be representative of what may be expected at the new Assembly Square development.

For the early phases of the program (before the new MBTA Orange Line station), the transit mode share for Assembly Square was determined using the existing Census data. This assumption is appropriate given ample transit service be provided to meet expected demand, which could involve improves bus service as well as potential new shuttle service. As such, a 22% residential, 13% office and 1% retail transit mode share can be assumed. Within the retail traffic considered, the employees of the retail stores may more closely resemble the travel characteristics of the office data shown above. However, as it is not possible to easily extract the number of employee trips occurring at each retail facility the analysis is conservative in that no credit was taken.

Following the construction of the new MBTA Orange Line Station, residential transit use should be considerably higher than that reflected by the current use in the Assembly Square area. With a new MBTA station, Alewife could provide a good indicator of residential transit use: 35-47%. The 47% transit share also coordinates well with the data from a demographically similar area in San Francisco, California where 46% transit usage was observed. These data are summarized and documented in greater detail in the Appendix to this report. From the Alewife station it takes about 22 minutes to reach Downtown Crossing, while it is estimated that from Assembly Square, the ride time would be more than ½ lower. It can be expected that with proper marketing, people will choose to live at Assembly Square due to quick access to downtown Boston and neighborhood-focused on-site retail.

Demographically, the new Assembly Square project may also attract residents similar to those at Alewife.

Office-related transit use should also obviously increase considerably with the construction of a new MBTA Orange Line station. With the low parking ratios that will be provided combined with other transportation demand management (TDM) measures discussed later in this report, it is expected that office transit usage would reach 25% following the construction of the new station.

While the existing retail transit use is estimated to be only 1%, it is also expected to increase significantly following the construction of the new MBTA station. However, retail is typically the most limited use as far as maximizing transit usage. This is due to the majority of the traffic associated with retail uses being from customers, which aren't affected to the same degree by TDM measures. Regardless, VHB expects that retail transit usage at the site should increase to 5% with the construction of the new MBTA station. It is important to note that transit use by employees of the various retail stores should also approach the 25% levels considered for office employees. However, VHB did not attempt to quantify the number of retail employees within the Assembly Square district and instead assumed a flat 5% retail transit credit.

Trip Generation Summary – IKEA and Assembly Square Mixed Use Development

Tables 16 through 18 present the total net new vehicle trips anticipated from the redevelopment project's new construction. The trip generation estimates presented for the Assembly Square mixed-use development in the prior tables presented only the raw trip generation totals, which were not adjusted to reflect internal shared trips, pass-by trips, or the effects of pedestrians, bicyclists, or transit use. By considering the anticipated internal trip sharing, and non-vehicular traffic expected to be associated with the project, the associated project impacts should be minimized as compared to what would be created with the raw trip generation levels presented earlier. Please note that the following tables consider the effect of transit, trip sharing, bike/pedestrian activity on the combined raw trip generation of both the Assembly Square mixed-use development *and IKEA*.

2011 "Short Term" Build Condition Trip Generation (with IKEA) - including transit, bikes/peds, and trip sharing

Table 16 presents the anticipated Assembly Square mixed-use development trip generation after transit use, bike/pedestrian activity, and shared trips have been properly accounted for in the analysis. To simplify the table, the total trips are shown, followed by the credits or reductions in traffic associated with internal

captured trips, transits, bike/pedestrians and pass-by traffic. From this analysis, the resulting net new vehicle trips can be compared to that which were shown in the initial unadjusted raw trip generation figures for this phase.

Table 16
Assembly Square Redevelopment Trip Generation Summary
Short-term (2011) – IKEA and mixed-use development

Time Period	Total Trips	Shared Trips	Transit/Bike/ Walk Credit	Pass-by Trips*	New Vehicle Trips
Weekday					
Daily (vpd)	16,240	3,590	1,060	1,540	10,050
Morning Peak (vph)					
Enter	250	0	20	25	205
Exit	435	0	80	25	330
Total	685	0	100	50	535
Evening Peak (vph)					
Enter	800	180	60	65	495
Exit	615	180	30	65	340
Total	1,415	360	90	130	835
Saturday					
Daily (vpd)	21,190	3,560	1,060	2,400	14,170
Midday Peak (vph)					
Enter	1,065	145	50	120	750
Exit	925	145	45	120	615
Total	1,990	290	95	240	1,365

a – vehicles per day
b – vehicles per hour
* - a pass-by rate of 25% was used for the retail portion of the project excluding IKEA; a pass-by rate of 13% was used for IKEA.

When the effects of trip sharing, pass-by traffic, transit use and bicycle/pedestrian activity are properly considered, the daily trip generation is reduced by 38% and 33% on a weekday daily and Saturday daily basis, respectively. Likewise, peak hour trip generation is between 22% and 41% lower than the raw trip generation figures presented in earlier in Table 11. The totals shown above reflect the anticipated non-vehicular traffic associated with the IKEA and Assembly Square mixed-use development. Unlike Table 11, which was used as the baseline condition for the information presented above, the Assembly Square Marketplace trip generation is not reflected in the table presented above. That is due to the Assembly Square Marketplace already being an occupied an active use that is currently generating traffic. The information used in the table presented above was used to specifically assign site-generated traffic to the roadway network. Accordingly, the Assembly Square Marketplace traffic was not included above as the effects of trip-sharing, pass-by traffic, transit use etc. are already inherent within the existing traffic counts. In developing the shared-trip estimates presented above, however, the interaction

with the existing Assembly Square Marketplace in the form of shared trips was considered.

The 2011 No-Build networks used as the baseline condition are shown in Figures 12 through 14. The subsequent 2011 Weekday Morning Build, 2011 Weekday Evening Build, and 2011 Saturday Midday Build peak hour networks are shown in Figures 15 through 17, respectively.

2014 "Mid Term" Build Condition Trip Generation (with IKEA) - including transit, bikes/peds, and trip sharing

Table 17 presents the anticipated Assembly Square mixed-use development trip generation after transit use, bike/pedestrian activity, and shared trips have been properly accounted for in the analysis. It should be noted that this table reflects the *cumulative* trip generation associated with the project to this point. The *incremental* impact of this phase can be determined by comparing its trip generation with that of the short-term phase (Table 16).

Table 17
Assembly Square Redevelopment Trip Generation Summary
Mid-term (2014) – IKEA and mixed-use development

Time Period	Total Trips	Shared Trips	Transit/Bike/ Walk Credit	Pass-by Trips*	New Vehicle Trips
Weekday					
Daily (vpd)	32,390	5,890	2,520	3,610	20,370
Morning Peak (vph)					
Enter	450	0	55	35	360
Exit	820	0	165	35	620
Total	1,270	0	220	70	980
Evening Peak (vph)					
Enter	1,590	285	140	155	1,010
Exit	1,220	285	70	155	710
Total	2,810	570	210	310	1,720
Saturday					
Daily (vpd)	39,250	7,210	2,390	4,770	24,880
Midday Peak (vph)					
Enter	1,920	210	120	235	1,355
Exit	1,590	210	105	235	1,040
Total	3,510	420	225	470	2,395

a – vehicles per day
b – vehicles per hour
* - a pass-by rate of 25% was used for the retail portion of the project excluding IKEA; a pass-by rate of 13% was used for IKEA.

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Route 28

Gov. Winthrop Road

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 12

2011 No-Build Conditions
Weekday Morning
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 13

2011 No-Build Conditions
Weekday Evening
Peak Hour Traffic Volumes

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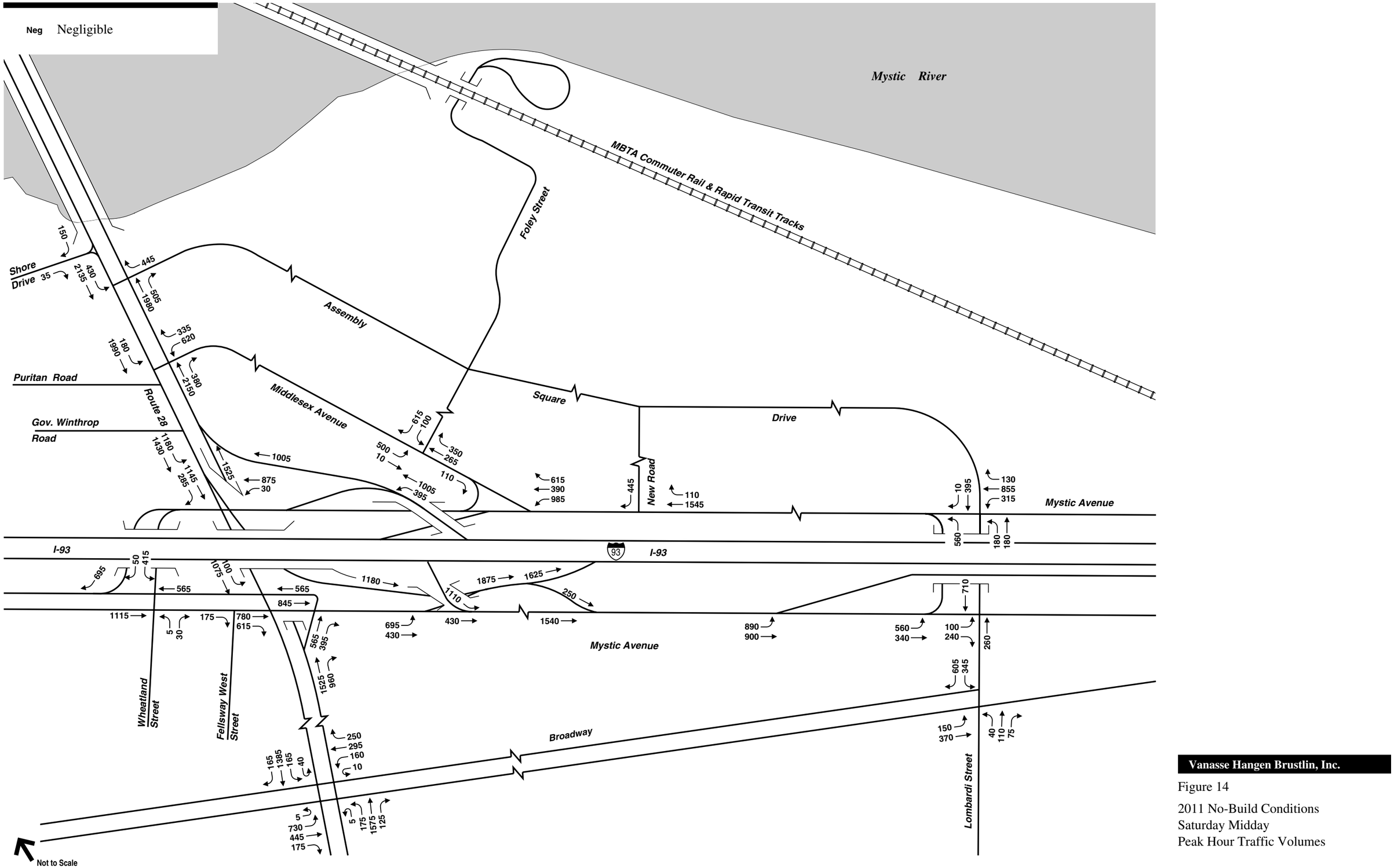
Neg Negligible



Vanasse Hangen Brustlin, Inc.

Figure 14

2011 No-Build Conditions
Saturday Midday
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 15

2011 Build Conditions
Weekday Morning
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Drive

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 16

2011 Build Conditions
Weekday Evening
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

150 35 425 2145 415 420 2005 335 655 165 2015 445 2090 1150 1520 1245 275 1585 950 840 30 655 70 125 260 550 10 950 400 80 385 390 950 430 295 1295 115 805 315 10 325 550 175 175 725 390 565 1175 100 565 885 1150 1850 1580 1080 270 1125 5 30 175 785 590 700 435 435 1515 905 880 640 550 330 90 240 260 565 395 1585 960 600 280 245 295 160 10 205 1425 160 40 145 370 40 115 75 5 750 445 175 5 175 1620 125

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 17

2011 Build Conditions
Saturday Midday
Peak Hour Traffic Volumes

When the effects of trip sharing, pass-by traffic, transit use and bicycle/pedestrian activity are properly considered, the daily trip generation is reduced by 37% on both a weekday daily and Saturday daily basis. Likewise, peak hour trip generation is between 23% and 39% lower than the raw trip generation figures presented in earlier in Table 13. The consistency in the percent reduction can be attributed to the similar mix of uses proposed in this phase, and the transit accommodations in the area remaining generally unchanged. As with the prior table for the 2011 "Short-Term" Build condition, the Assembly Square Marketplace trip generation is not included in the table presented above. The information presented above was used to specifically assign site-generated traffic to the roadway network. As the effects of trip-sharing, pass-by traffic, transit use etc. are already inherent within the existing traffic counts. However, the shared trips estimate presented above does reflect the anticipated interaction between the proposed mixed-use development and the existing Assembly Square Marketplace.

The 2014 No-Build networks used as the baseline condition are shown in Figures 18 through 20. The subsequent 2014 Weekday Morning Build, 2014 Weekday Evening Build, and 2014 Saturday Midday Build peak hour networks are shown in Figures 21 through 23, respectively. As discussed later in the Traffic Operations Analysis section, mitigation for this project will result in changes in traffic patterns in this area. Accordingly, Build with mitigation networks reflecting these changes were developed for the Weekday Morning, Weekday Evening and Saturday Midday peak hours were developed for the 2014 design year. The 2014 Build with mitigation networks are shown in Figures 24 through 26.

2018 "Long Term" Build Condition Trip Generation (with IKEA) - including transit, bikes/peds, and trip sharing

Table 18 presents the anticipated Assembly Square mixed-use development trip generation after transit use, bike/pedestrian activity, and shared trips have been properly accounted for in the analysis. It should be noted that this table reflects the *cumulative* trip generation associated with the project to this point. The *incremental* impact of this phase can be determined by comparing its trip generation with that of the mid-term phase (Table 17).

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

New Road

Drive

Mystic Avenue

I-93

93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

125 30 3610 75 50 110 1780 170 340 225 3415 220 1720 340 15 30 150 355 10 955 280 25 985 955 1560 2195 1915 280 495 5 0 180 195 815 140 80 1050 20 200 40 875 175 150 140 50 550 5 220 605 110 1810 605 850 1560 1105 2710 2040 670 1630 5 35 200 740 945 1150 370 370 1475 1675 470 150 320 35 285 375 155 605 375 985 980 360 300 180 250 115 5 135 2445 110 15 0 570 555 250 10 110 1315 60 70 425 30 85 80

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 18

2014 No-Build Conditions
Weekday Morning
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

New Road

Drive

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 19

2014 No-Build Conditions
Weekday Evening
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 20

2014 No-Build Conditions
Saturday Midday
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Drive

Puritan Road

Route 28

Gov. Winthrop Road

Middlesex Avenue

New Road

Mystic Avenue

I-93

93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

125 70 30 3605 95 205 1775 170 575 225 3410 235 1810 1645 2340 2055 285 1060 985 495 5 0 575 20 55 150 370 10 985 275 30 205 195 845 170 80 1075 20 205 40 880 175 170 140 60 550 5 225 605 110 1945 605 860 1645 1120 2795 2115 680 1640 5 35 205 750 945 1150 380 380 1500 605 375 1060 980 1685 495 170 325 40 285 380 160 360 305 180 250 115 5 170 2545 110 15 0 595 555 250 10 110 1365 60 70 425 30 90 80

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 21

2014 Build Conditions
Weekday Morning
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Drive

Puritan Road

Route 28

Gov. Winthrop Road

Middlesex Avenue

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 22

2014 Build Conditions
Weekday Evening
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 23

2014 Build Conditions
Saturday Midday
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 24

2014 Build with Mitigation Conditions
Weekday Morning
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 25

2014 Build with Mitigation Conditions
Weekday Evening
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Route 28

Middlesex Avenue

Gov. Winthrop Road

Drive

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 26

2014 Build with Mitigation Conditions
Saturday Midday
Peak Hour Traffic Volumes

Table 18
Assembly Square Redevelopment Trip Generation Summary
Long-term (2018) – IKEA and mixed-use development

Time Period	Total Trips	Shared Trips	Transit/Bike/ Walk Credit	Pass-by Trips*	New Vehicle Trips
Weekday					
Daily (vpd)	44,890	8,310	9,580	3,160	23,840
Morning Peak (vph)					
Enter	2,085	0	625	35	1,425
Exit	1,045	0	430	35	580
Total	3,130	0	1,055	70	2,005
Evening Peak (vph)					
Enter	1,960	370	430	140	1,020
Exit	2,935	370	690	140	1,735
Total	4,895	740	1,120	280	2,755
Saturday					
Daily (vpd)	43,540	8,720	7,410	4,340	23,070
Midday Peak (vph)					
Enter	2,150	295	380	210	1,265
Exit	1,790	295	325	210	960
Total	3,940	590	705	420	2,225

a – vehicles per day
b – vehicles per hour
* - a pass-by rate of 25% was used for the retail portion of the project excluding IKEA; a pass-by rate of 13% was used for IKEA.

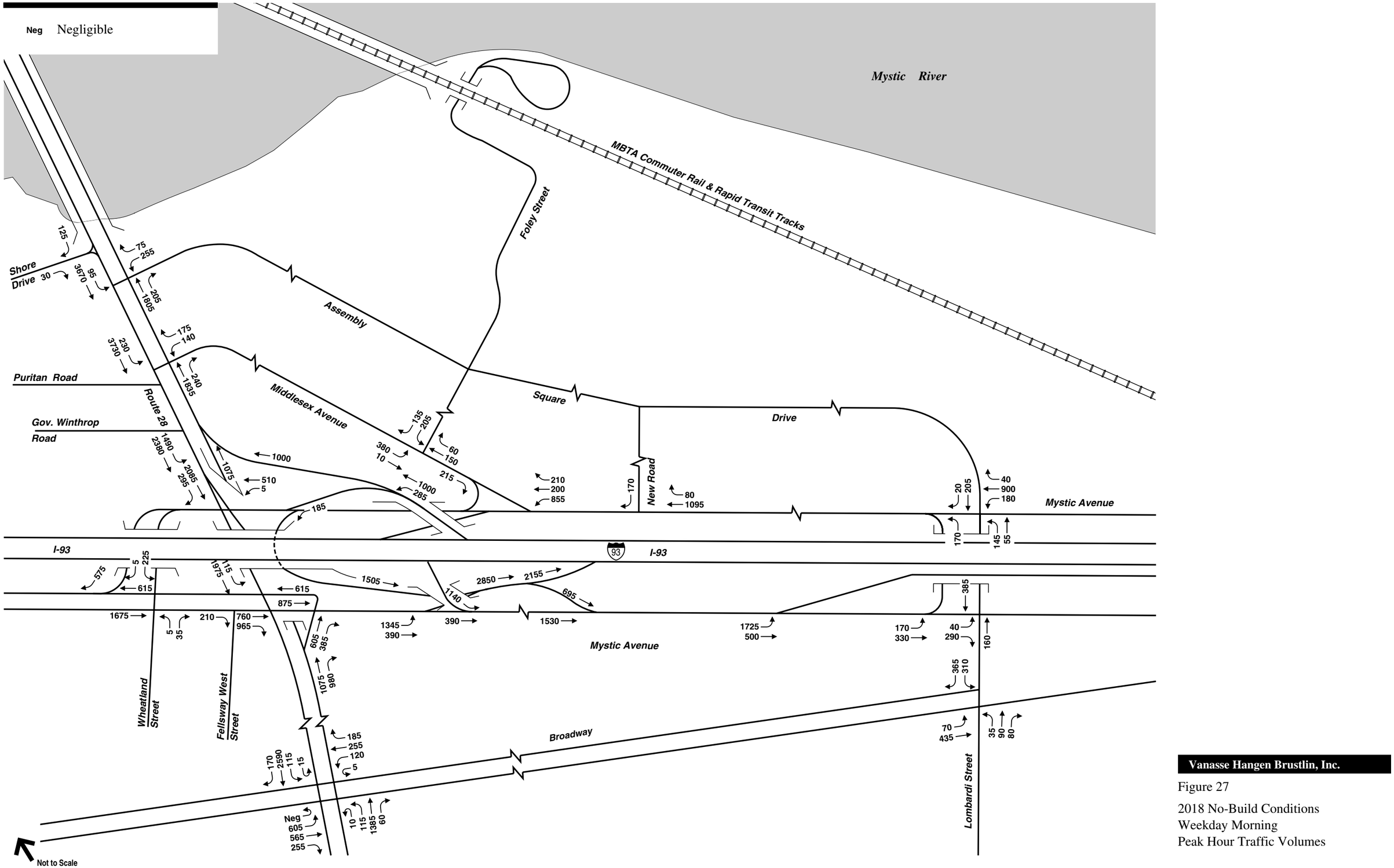
As expected, Table 18 shows that with the construction of the new MBTA Orange Line station there will be a considerable increase in the percentage of traffic traveling to and from the site via public transportation, or as pedestrians or bicyclists, compared to current conditions. The figures presented above were developed following a thorough analysis of both existing public transportation accommodations compared to those that will be available in the future. Additional census data for the nearby area in Somerville were also referenced in the analysis. When possible, VHB compared existing transit usage at comparable areas and at comparable MBTA stations in developing the transit use projections used in this analysis. Of the residential uses on site, it is expected that approximately 47% will travel to the site by way of public transportation. Likewise, approximately 25% of the office employees at the site could now be expected to arrive via public transportation. While retail transit use will not be as prevalent, it is still expected that 5% of the retail customer traffic to and from the site could now use public transportation. Transit use by employees should also likely approach the 25% levels considered for office employees, but VHB did not attempt to quantify the number of retail employees within the Assembly Square district. Accordingly, while a flat 5% retail transit credit was assumed in the analysis, actual usage could be slightly higher due to public transportation use by employees of the retail stores.

When the transit projections noted above are applied to the raw trip generation, and other factors such as trip sharing, pass-by traffic, etc., are considered the daily trip generation is reduced by 47% on both a weekday daily and Saturday daily basis. Likewise, peak hour trip generation is between 36% and 44% lower than the raw trip generation figures presented in earlier in Table 15.

As with the prior tables, the Assembly Square Marketplace trip generation is not included in the table presented above. The information presented above was used to specifically assign site-generated traffic to the roadway network. As the effects of trip-sharing, pass-by traffic, transit use etc. are already inherent within the existing traffic counts. However, the shared trips estimate presented above does reflect the anticipated interaction between the proposed mixed-use development and the existing Assembly Square Marketplace. Regardless, all of the traffic associated with the Assembly Square Marketplace component of the project is properly accounted for as it is already included in the existing and no-build volumes upon which all of the future build condition networks were developed.

The 2018 No-Build networks used as the baseline condition are shown in Figures 27 through 29. The subsequent 2018 Weekday Morning Build, 2018 Weekday Evening Build, and 2018 Saturday Midday Build peak hour networks are shown in Figures 30 through 32, respectively. These networks reflected the previously discussed traffic pattern changes resulting from mitigation proposed in conjunction with the 2014 mid-term Build condition.

Neg Negligible



Vanasse Hangen Brustlin, Inc.

Figure 27

2018 No-Build Conditions
Weekday Morning
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Drive

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 28

2018 No-Build Conditions
Weekday Evening
Peak Hour Traffic Volumes

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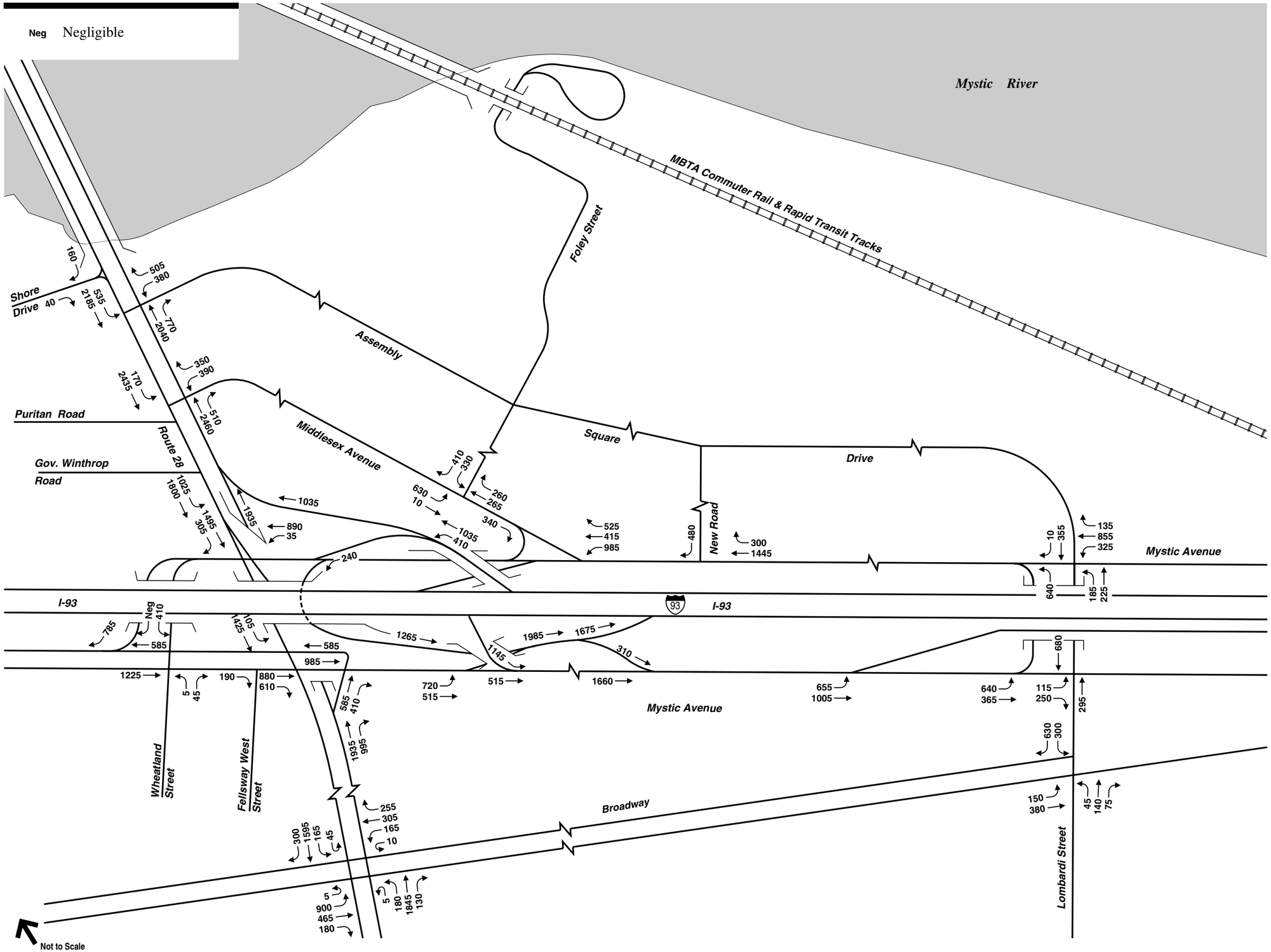
Neg Negligible



Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 29

2018 No-Build Conditions
Saturday Midday
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Route 28

Gov. Winthrop Road

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 30

2018 Build Conditions
Weekday Morning
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Puritan Road

Route 28

Gov. Winthrop Road

Middlesex Avenue

Drive

New Road

Mystic Avenue

I-93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 31

2018 Build Conditions
Weekday Evening
Peak Hour Traffic Volumes

Neg Negligible

Mystic River

MBTA Commuter Rail & Rapid Transit Tracks

Foley Street

Shore Drive

Assembly Square

Drive

Puritan Road

Gov. Winthrop Road

Route 28

Middlesex Avenue

New Road

Mystic Avenue

I-93

93

Wheatland Street

Fellsway West Street

Broadway

Lombardi Street

Not to Scale

Vanasse Hangen Brustlin, Inc.

Figure 32

2018 Build Conditions
Saturday Midday
Peak Hour Traffic Volumes

4

Traffic Operations Analysis

Measuring existing traffic volumes and projecting future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity analyses were conducted with respect to Existing and projected No-Build and Build traffic volume conditions. However, for the proposed Assembly Square Mixed-Use Redevelopment project this effort is further complicated by the complex phasing of the project. Accordingly, No-Build and Build conditions needed to be analyzed for the 2011, 2014 and 2018 design years to reflect each phase of development, and the planned mitigation and roadway improvements built upon each prior phase. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them. Roadway operating conditions are classified by calculated levels of service.

Level-of-Service Criteria

The evaluation criteria used to analyze area intersections and roadways in this traffic study are based on the 2000 *Highway Capacity Manual* [HCM][6]. Level of service [LOS] is the term used to denote the different operating conditions that occur on a given roadway segment under various traffic volume loads. It is a qualitative measure that considers a number of factors including roadway geometry, speed, travel delay, freedom to maneuver, and safety. Level of service provides an index to the operational qualities of a roadway segment or an intersection. Level-of-service designations range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions.

The level-of-service designation is reported differently for signalized and unsignalized intersections. For signalized intersections, the analysis considers the operation of all traffic entering the intersection and the LOS designation is for overall conditions at the intersection. For unsignalized intersections, however, the analysis assumes that traffic on the mainline is not affected by traffic on the side streets. Thus, the LOS designation is for the critical movement entering or exiting the side street, which is generally the left-turn out of the side street.

♦

[6] Transportation Research Board, Highway Capacity Manual, Washington, D.C., 2000.

It should be noted that the analytical methodologies typically used for the analysis of unsignalized intersections use conservative analysis parameters, such as long critical gaps. Actual field observations indicate that drivers on minor streets generally accept shorter gaps in traffic than those used in the analysis procedures and therefore experience less delay than reported by the analysis software. The analysis methodologies also do not fully take into account the beneficial grouping effects caused by nearby signalized intersections. The net effect of these analysis procedures is the over-estimation of calculated delays at unsignalized intersections in the study area. Cautious judgment should therefore be exercised when interpreting the capacity analysis results at unsignalized intersections.

Level-of-Service Analysis

Levels of service analyses were conducted for the Existing, No-Build, and Build conditions for the study-area intersections.

Signalized Intersection Capacity Analysis 2006 and 2011

Table 19 presents a summary of the signalized capacity analyses for the signalized intersections in the study area. The results shown are for the 2006 Existing Conditions scenario as compared to the 2011 No-Build and Build conditions. Where appropriate and necessary, improvements required as project mitigation were analyzed as presented under the 2011 Build with mitigation column. The capacity analyses worksheets are included in the appendix.

Table 19
2011 Signalized Intersection Capacity Analysis Summary

Location	Period	2006 Existing v/c *	2006 Existing Delay **	2006 Existing LOS ***	2011 No-Build v/c	2011 No-Build Delay	2011 No-Build LOS	2011 Build v/c	2011 Build Delay	2011 Build LOS	2011 Build w/ Mit. v/c	2011 Build w/ Mit. Delay	2011 Build w/ Mit. LOS
Route I-93/Route 28/Mystic Avenue Interchange													
Route 28 SB at	Weekday Morning	0.59	65	E	0.65	108	F	0.68	139	F	0.68	56	E
Mystic Avenue NB/	Weekday Evening	0.50	26	C	0.63	32	C	0.61	31	C	0.61	31	C
Connector Road	Saturday Midday	0.50	16	B	0.65	22	C	0.63	22	C	0.63	22	C
Route 28 SB at	Weekday Morning	0.70	7	A	0.77	9	A	0.81	15	B	0.81	8	A
Mystic Avenue SB	Weekday Evening	0.44	8	A	0.63	10	B	0.55	7	A	0.55	7	A
	Saturday Midday	0.51	6	A	0.66	7	A	0.64	7	A	0.64	7	A
Wheatland Street at	Weekday Morning	0.59	20	B	0.63	22	C	0.64	23	C	0.64	47	D
Mystic Avenue SB	Weekday Evening	0.43	13	B	0.50	14	B	0.48	14	B	0.48	14	B
	Saturday Midday	0.47	11	B	0.52	10	B	0.51	10	B	0.51	10	B
Route 28 NB Connector Road at	Weekday Morning	0.41	27	C	0.49	28	C	0.49	28	C	0.48	29	C
Mystic Avenue SB	Weekday Evening	0.45	32	C	0.80	37	D	0.51	33	C	0.51	33	C
	Saturday Midday	0.40	19	B	0.46	21	C	0.48	22	C	0.48	22	C
Route 28 at	Weekday Morning	0.68	2	A	0.75	3	A	0.74	4	A	0.74	2	A
Assembly Square Drive	Weekday Evening	0.71	6	A	0.86	37	D	0.95	45	D	0.92	10	A
	Saturday Midday	0.59	4	A	0.88	11	B	0.85	9	A	0.85	9	A
Route 28 at	Weekday Morning	0.73	11	B	0.83	24	C	0.98	30	C	0.92	17	B
Middlesex Avenue	Weekday Evening	0.82	30	C	0.99	82	F	0.95	90	F	0.95	32	C
	Saturday Midday	0.55	10	A	0.86	46	D	0.86	52	D	0.87	28	C
Route 28 at	Weekday Morning	0.90	94	F	0.99	129	F	1.03	147	F			
Broadway	Weekday Evening	0.83	56	E	1.14	140	F	1.17	145	F			
	Saturday Midday	0.85	38	D	0.99	66	E	1.01	74	E			
Lombardi Street at	Weekday Morning	0.43	8	A	0.42	19	B	0.43	19	B			
Broadway	Weekday Evening	0.50	9	A	0.55	7	B	0.55	17	B			
	Saturday Midday	0.42	8	A	0.49	16	B	0.49	16	B			
Lombardi Street/	Weekday Morning	0.34	11	B	0.34	22	C	0.35	22	C	0.44	19	B
Assembly Square Drive at	Weekday Evening	0.67	15	B	0.74	30	C	0.70	22	C	0.76	25	C
Mystic Avenue NB	Saturday Midday	0.38	11	B	0.43	27	C	0.40	26	C	0.50	18	B
New Road at	Weekday Morning	0.07^	11^	B^	0.25	4	A	0.27	6	A			
Mystic Avenue NB	Weekday Evening	0.33^	20^	C^	0.71	10	A	0.67	9	A			
	Saturday Midday	0.19^	12^	B^	0.54	11	B	0.48	11	B			
Foley Street at	Weekday Morning	0.02^	20^	C^	0.30	13	B	0.40	10	A			
Middlesex Avenue	Weekday Evening	0.18^	23^	C^	0.69	18	B	0.47	11	B			
	Saturday Midday	0.42^	47^	E^	0.72	14	B	0.76	14	B			
Mystic Avenue NB at	Weekday Morning										0.27	4	A
Mystic Avenue U-turn	Weekday Evening										0.63	6	A
	Saturday Midday										0.40	10	A

* V/C = volume to capacity ratio
** Delay = Average delay in seconds per vehicle
*** LOS = Level of Service
\+ Delay cannot be calculated for V/C > than 1.2 for signalized intersections.
^ Intersection operates under Stop control in existing conditions. v/c, delay and LOS shown for critical approach only.
n/a Not applicable

As shown in Table 19, the analysis results for the Route I-93/Route 28/Mystic Avenue interchange have been grouped together as the individual intersections currently operate as a system under a single traffic signal controller. These intersections currently operate well below capacity, though the Route 28 southbound/Mystic Avenue northbound intersection presently function with long delays during the weekday morning peak hour. Improvements to this location were planned as mitigation for the IKEA project at the formerly proposed waterfront location. These improvements, which primarily addressed safety concerns and signal visibility, will be implemented as mitigation for the 2011 Short-Term Build condition. The Build with Mitigation columns reflects suggested minor modifications in the current signal timings which should be implemented as project mitigation during this stage.

Both Route 28's intersections with Assembly Square Drive and Middlesex Avenue operate acceptably under existing conditions. With the additional traffic anticipated under the 2011 Short-Term Build condition additional delays are expected, with both locations approaching theoretical capacity. According, the 2011 Build with Mitigation condition reflects suggested changes in signal timing which should be implemented as mitigation during this phase.

The Mystic Avenue northbound/Lombardi Avenue/Assembly Square Drive intersection currently operates at acceptable levels of service during the time periods studied. With the additional traffic projected under the 2011 Short-Term Build condition this location can still operate acceptably. However, by reducing the number of approach lanes on Assembly Square Drive from two to one, improved bicycle accommodations can be provided on Assembly Square Drive. Accordingly, the mitigation under the 2011 Build with Mitigation condition (which is not intended to address capacity concerns) results in the intersection still operating acceptably.

Under the 2011 Short-Term Build condition it is recommended that a signal be installed at the U-turn underpass ramp extending from the Mystic Avenue/Route I-93 southbound off-ramp to Mystic Avenue northbound. As shown in Table 19 this signal would operate acceptably during all of the time periods considered. More detailed discussion regarding this location is provided within the Mitigation Chapter of this report.

■

Signalized Intersection Capacity Analysis - 2014

Table 20 presents a summary of the signalized capacity analyses for the signalized intersections in the study area. The results shown are for the 2014 No-Build, 2014 Build and 2014 Build with Mitigation conditions. The capacity analyses worksheets are included in the appendix.

Table 20
2014 Signalized Intersection Capacity Analysis Summary

Location	Period	2014 No-Build v/c	2014 No-Build Delay	2014 No-Build LOS	2014 Build v/c	2014 Build Delay	2014 Build LOS	2014 Build w/ Mit. v/c	2014 Build w/ Mit. Delay	2014 Build w/ Mit. LOS
Route I-93/Route 28/Mystic Avenue Interchange										
Route 28 SB at	Weekday Morning	0.69	60	E	0.72	82	F	0.68	60	E
Mystic Avenue NB/	Weekday Evening	0.62	31	C	0.67	36	D	0.62	34	C
Connector Road	Saturday Midday	0.64	23	C	0.68	31	C	0.59	25	C
Route 28 SB at	Weekday Morning	0.82	8	A	0.85	9	A	0.83	7	A
Mystic Avenue SB	Weekday Evening	0.56	7	A	0.61	8	A	0.59	7	A
	Saturday Midday	0.65	8	A	0.72	10	B	0.67	9	A
Wheatland Street at	Weekday Morning	0.64	50	D	0.65	52	D	0.60	58	E
Mystic Avenue SB	Weekday Evening	0.49	14	B	0.51	15	B	0.44	13	B
	Saturday Midday	0.52	10	B	0.55	11	B	0.45	9	A
Route 28 NB Connector Road at	Weekday Morning	0.49	30	C	0.49	30	C	0.46	29	C
Mystic Avenue SB	Weekday Evening	0.52	33	C	0.54	33	C	0.48	33	C
	Saturday Midday	0.48	23	C	0.52	24	C	0.43	21	C
Route 28 at	Weekday Morning	0.75	2	A	0.75	3	A	0.90	16	B
Assembly Square Drive	Weekday Evening	0.93	10	B	1.07	36	D	0.92	25	C
	Saturday Midday	0.86	10	A	0.99	26	C	0.79	30	C
Route 28 at	Weekday Morning	0.93	18	B	1.03	40	D	0.86	16	B
Middlesex Avenue	Weekday Evening	0.97	35	C	1.15	82	F	1.03	44	D
	Saturday Midday	0.88	30	C	1.06	85	F	0.75	16	B
Route 28 at	Weekday Morning	1.05	152	F	1.09	17	F			
Broadway	Weekday Evening	1.15	151	F	1.27	178	F			
	Saturday Midday	1.02	78	E	1.12	116	F			
Lombardi Street at	Weekday Morning	0.43	18	B	0.44	18	B			
Broadway	Weekday Evening	0.56	17	B	0.56	17	B			
	Saturday Midday	0.50	17	B	0.52	17	B			
Lombardi Street/	Weekday Morning	0.37	18	B	0.37	18	B	0.45	20	B
Assembly Square Drive at	Weekday Evening	0.69	26	C	0.71	28	C	0.79	28	C
Mystic Avenue NB	Saturday Midday	0.41	16	B	0.42	17	B	0.52	19	B
New Road at	Weekday Morning	0.28	9	A	0.30	10	A			
Mystic Avenue NB	Weekday Evening	0.68	10	B	0.72	11	B			
	Saturday Midday	0.48	13	B	0.53	13	B			
Foley Street at	Weekday Morning	0.41	10	A	0.50	9	A	0.32	17	B
Middlesex Avenue	Weekday Evening	0.47	11	B	0.77	15	B	0.45	14	B
	Saturday Midday	0.76	14	B	1.14	76	E	0.65	22	C
Mystic Avenue NB at	Weekday Morning	0.28	4	A	0.28	5	A			
Mystic Avenue U-turn	Weekday Evening	0.64	7	A	0.67	7	A			
	Saturday Midday	0.41	10	A	0.45	11	B			

* V/C = volume to capacity ratio
** Delay = Average delay in seconds per vehicle
*** LOS = Level of Service
\+ Delay cannot be calculated for V/C > than 1.2 for signalized intersections.
^ Intersection operates under Stop control in existing conditions. v/c, delay and LOS shown for critical approach only.
n/a Not applicable

As shown in Table 20, the Route I-93/Route 28/Mystic Avenue interchange will continue to operate below capacity under the 2014 Build condition. However, the delays at the Route 28 southbound/Mystic Avenue northbound intersection will increase during the weekday morning peak hour with the additional project related traffic. Proposed mitigation involving creating a U-turn slot extending from Mystic Avenue northbound onto the Route I-93 on-ramp will also help alleviate congestion at this location. This improvement is discussed in detail in the Mitigation chapter of this report. The benefits associated with this mitigation are reflected under the 2014 Build with mitigation condition which shows that the Route I-93/Route 28/Mystic Avenue interchange will operate acceptably, though with long delays during the weekday morning peak hour.

Exiting left-turns are planned to be allowed from Assembly Square Drive onto Route 28 as project mitigation for the 2014 Mid-Term Build condition. With this change, Route 28's intersections with both Middlesex Avenue and Assembly Square Drive will operate at acceptable levels of service under the 2014 Build with Mitigation condition. More information regarding the nature of this mitigation, which will require input and approval from both the City of Somerville and the Department of Conservation and Recreation (DCR) is provided in the Mitigation chapter of this report.

The mitigation results shown for the Mystic Avenue northbound/Lombardi Avenue/Assembly Square Drive intersection reflect minor signal timing changes. These changes should be implemented as mitigation for the 2014 Mid-Term Build condition to better accommodate the revised travel patterns resulting from the other mitigation noted above.

With the additional traffic generated under the 2014 Mid-Term Build condition modifications will be required to the Middlesex Avenue/Foley Street intersection. As shown in Table 20, this intersection will operate over capacity during the Saturday midday peak hour in the absence of any improvements.

The proposed Mystic Avenue U-turn slot underneath Route I-93 will provide a new option for motorists exiting Assembly Square who wish to return to Route I-93 south. Accordingly, it is expected that there may be a shift in traffic from Foley Street due to this change. Traffic that formerly turned right from Foley Street onto Middlesex Avenue to access the Route I-93 southbound ramp can now instead turn left and then immediately onto Mystic Avenue U-turn slot. This will allow these motorists to avoid two traffic signals on Route 28, which will help minimize impacts to that corridor. With this change, it is recommended that the lane use on Foley Street be changed. The current separate exclusive left- and right-turn lanes on Foley Street should be replaced with an exclusive left-turn lane and a shared left-/right-turn lane. Likewise, the lane use on the southbound Middlesex Avenue approach should be modified to replace the current separate exclusive left-turn lane and through-lane

with an exclusive left-turn lane and a shared left-/through lane. Both of the lane-uses changes noted above will require modified signal phasing and timing plans be implemented. More detailed discussion of this mitigation measure is provided in the Mitigation chapter of this report. With these changes, the intersection will operate acceptably as shown in Table 20.

■

Signalized Intersection Capacity Analysis - 2018

Table 21 presents a summary of the signalized capacity analyses for the signalized intersections in the study area. The results shown are for the 2018 No-Build and 2018 Build conditions. The capacity analyses worksheets are included in the appendix.

As shown in Table 22, the impacts with the additional traffic associated with the 2018 Long-Term Build condition are lessened by the new MBTA Orange Line Station which is expected to be operating by that time. As discussed earlier in the Trip Generation section of this report, the new station will result in pronounced changes in method of travel to the site. Even with the new transit station, the 1.75 million square feet office proposed under the 2018 Long-Term Build condition will obviously generate additional vehicular traffic. However, at the same time, there will be a sizable reduction in the amount of residential vehicular traffic to and from the site due to the new station. Some degree of retail vehicular traffic to and from the site will also be reduced with the new station. The mixed-use nature of the site also provides some degree of balance between traffic entering and exiting Assembly Square. For example, while there will be a sizable volume of residential traffic exiting the site during the weekday morning peak hour, the overwhelming majority of office traffic will be in the opposite direction entering the site during the same time period. Similar benefits are experienced during the other time periods analyzed. Considering these factors the roadway infrastructure provided with the traffic mitigation proposed under the prior phases can adequately accommodate the full build-out of the site. While the Route 28/Assembly Square and Route 28/Middlesex Avenue intersection will operate at LOS D during the weekday evening peak hour, both locations will be operating slightly over capacity. The provision of the new MBTA Orange Line station and transportation demand management measures discussed in the Mitigation chapter should help to minimize traffic at these locations to some degree. As under the prior analysis conditions, the Route 28/Broadway intersection is projected to operate over capacity during all time periods. The maximum lane use and signal accommodations appear to have already been provided at this location and further improvements are not possible without land takings of several properties abutting the intersection.

Table 21
2018 Signalized Intersection Capacity Analysis Summary

Location	Period	2018 No-Build v/c	2018 No-Build Delay	2018 No-Build LOS	2018 Build v/c	2018 Build Delay	2018 Build LOS
Route I-93/Route 28/Mystic Avenue Interchange							
Route 28 SB at	Weekday Morning	0.72	66	E	0.71	61	E
Mystic Avenue NB/	Weekday Evening	0.68	35	C	0.75	56	E
Connector Road	Saturday Midday	0.67	26	C	0.66	23	C
Route 28 SB at	Weekday Morning	0.87	9	A	0.87	9	A
Mystic Avenue SB	Weekday Evening	0.62	8	A	0.67	9	A
	Saturday Midday	0.73	11	B	0.72	10	A
Wheatland Street at	Weekday Morning	0.66	62	E	0.68	70	E
Mystic Avenue SB	Weekday Evening	0.52	15	B	0.52	15	B
	Saturday Midday	0.56	11	B	0.56	11	B
Route 28 NB Connector Road at	Weekday Morning	0.51	30	C	0.54	30	C
Mystic Avenue SB	Weekday Evening	0.55	34	C	0.55	34	C
	Saturday Midday	0.54	26	C	0.54	25	C
Route 28 at	Weekday Morning	0.91	17	B	0.88	18	B
Assembly Square Drive	Weekday Evening	0.94	28	C	1.03	36	D
	Saturday Midday	0.80	31	C	0.78	30	C
Route 28 at	Weekday Morning	0.87	17	B	0.86	18	B
Middlesex Avenue	Weekday Evening	1.05	48	D	1.04	46	D
	Saturday Midday	0.79	17	B	0.77	17	B
Route 28 at	Weekday Morning	1.11	180	F	1.13	172	F
Broadway	Weekday Evening	1.29	186	F	1.29	200	F
	Saturday Midday	1.14	122	F	1.12	113	F
Lombardi Street at	Weekday Morning	0.45	18	B	0.46	18	B
Broadway	Weekday Evening	0.57	17	B	0.57	17	B
	Saturday Midday	0.53	17	B	0.52	17	B
Lombardi Street/	Weekday Morning	0.46	20	C	0.47	20	C
Assembly Square Drive at	Weekday Evening	0.81	29	C	0.82	30	C
Mystic Avenue NB	Saturday Midday	0.54	20	B	0.53	20	B
New Road at	Weekday Morning	0.31	10	A	0.42	10	A
Mystic Avenue NB	Weekday Evening	0.73	12	B	0.91	36	D
	Saturday Midday	0.54	12	B	0.54	12	B
Foley Street at	Weekday Morning	0.33	17	B	0.35	19	B
Middlesex Avenue	Weekday Evening	0.44	13	B	0.60	16	B
	Saturday Midday	0.61	24	C	0.59	24	C
Mystic Avenue NB at	Weekday Morning	0.29	5	A	0.41	10	A
Mystic Avenue U-turn	Weekday Evening	0.68	7	A	0.69	8	A
	Saturday Midday	0.46	10	B	0.46	10	A

* V/C = volume to capacity ratio
** Delay = Average delay in seconds per vehicle
*** LOS = Level of Service
\+ Delay cannot be calculated for V/C > than 1.2 for signalized intersections.
^ Intersection operates under Stop control in existing conditions. v/c, delay and LOS shown for critical approach only.
n/a Not applicable

5 Mitigation

Based on the proposed development impacts, background growth, nearby proposed projects, and consultation with the City of Somerville, Federal Investment Realty Trust has committed to provide significant pedestrian and traffic improvements within the study area. These measures are intended both to mitigate potential impacts associated with the additional project traffic, and to help address existing traffic operational and safety deficiencies where possible. The mitigation and improvements are proposed on a phased basis, corresponding with the individual developments phases and potential project impacts. The proponent is also committed to provide funding to be used towards additional traffic and roadway improvements that are not related to specific project impacts. This would include significant financial contributions towards the funding of the proposed MBTA Orange Line Station, and funding for significant pedestrian enhancements in the area among other items. These contributions and the overall mitigation program will be formally documented in an Amended and Restated Development Covenant and Yard 21 Land Development Agreement reflecting the current development plans and proposed IKEA project relocation.

The planned specific traffic mitigation plan, transportation demand management measures to help minimize single-occupant motor vehicle travel to the site, and general site access plan are described in detail in the following sections. These mitigation measures will discussed in sections focusing on off-site roadway improvements, financial contributions, transportation demand management, and the internal site layout.

Off-site Roadway Improvements

To mitigate the Project's impacts, and to address existing deficiencies in this area, Federal Investment Realty Trust (FRIT) is committed to implementing the following physical mitigation measures. These measures will be implemented on a phased basis corresponding with the specific stage of the overall development program in which project related impacts are anticipated to require mitigation:

■

Broadway at Mt. Vernon Street/Lombardi Street

Improvements were previously proposed at this location as mitigation for the IKEA project in its former waterfront location. While the anticipated IKEA trip generation is lower than that previously anticipated in earlier studies, improvements at this locations still appear to be appropriate. Accordingly, the following measures will be implemented in conjunction with the IKEA portion of the planned 2011 "Short-Term" Build condition as defined earlier in this study:

- Install vehicle loop detectors
- Install pedestrian push button on signal mast arm support and upgrade all pedestrian signal heads and push buttons
- Upgrade/install emergency vehicle pre-emption
- Restripe existing pavement markings

VHB had previously conducted an inventory of the signal controller at this location and found that it is capable of accommodating the vehicular and pedestrian phasing proposed at this location. Accordingly, a new traffic signal controller is not required at this location.

Capacity analyses indicate that the unsignalized left-turn movement turning from the Route I-93 Southbound off-ramp heading northbound onto Lombardi Street will operate acceptably during all of the time periods and conditions analyzed. However, this location should be monitored following the first phase of development to determine if turn restrictions would be necessary or beneficial. This monitoring should consist of manual turning movement counts conducted during the weekday morning, weekday evening, and Saturday midday peak periods with corresponding capacity analyses being conducted. If queues or delays at this location prove to be problematic (which is not anticipated) then the left-turns from the ramp could be restricted with a modification to the end of the ramp along with accompanying signage. This monitoring should be conducted at three months and six months following the completion of the 2011 Short-Term Build phase, with a report being provided to the city for review. If required, the Proponent will implement the physical changes that would be needed to restrict the turns.

■

Mystic Avenue/Lombardi Street/Assembly Square Drive

Mitigation for the IKEA project at its formerly proposed waterfront location was also previously planned for this intersection. To accommodate the proposed IKEA at its new location, with the accompanying residential and retail traffic anticipated for the 2011 Short-Term Build condition, these measures should be implemented in conjunction with the IKEA component of the first development phase of this study:

- Replace existing mast-arm signal supports and signal heads with new equipment
- Install vehicle loop detectors
- Install pedestrian push button on signal mast arm support and upgrade all pedestrian signal heads and push buttons
- Upgrade/install emergency vehicle pre-emption
- Refresh pavement markings
- Modify the southbound Assembly Square Drive approach to feature a single lane approaching the signal, instead of the current two lane approach. While the signal can operate acceptably with either configuration, reducing the number of lanes on this approach will allow for enhanced bicycle accommodations on that approach.

VHB had previously conducted an inventory of the signal controller at this location and found that it is capable of accommodating the vehicular and pedestrian phasing proposed at this location. Accordingly, a new traffic signal controller is not required at this location. Following the construction of the 2014 Mid-Term Build condition signal timing modifications will be required. These will be required to accommodate both the additional traffic through this area, as well as the change in traffic patterns expected to result from other mitigation as discussed later in this section.

■

Lombardi Street Signal Interconnection

With the planned signal improvements to both the Mystic Avenue/Lombardi Street/Assembly Square Drive and Broadway/Lombardi Street/Mt. Vernon Street intersections, an interconnection should also be provided between these two locations. This would be intended not to provide the typical signal coordination frequently associated with interconnection but, rather, to prevent vehicles queues at one location from backing up to the other. To provide this communication, the proponent will install underground signal conduit along the westerly side of Lombardi Street between the two intersections. This will also allow both locations to be incorporated into a closed-loop system to be operated by the City's Traffic and Parking Department.

■

Mystic Avenue Northbound at Mystic Avenue Southbound U-turn Underpass

Under existing conditions, traffic arriving to the Assembly Square District from the north on Route I-93 can access the area via a U-turn underpass ramp extending from the Mystic Avenue/Route I-93 southbound off-ramp to Mystic Avenue northbound. This ramp is located immediately north of Lombardi Street and traffic turning from

the ramp currently intersects Mystic Avenue northbound at a point approximately 100 feet north of the Mystic Avenue northbound/Assembly Square Drive/Lombardi Street signalized intersection. With the increased traffic anticipated with the first phase of development, this location should be signalized. The required signal warrants are satisfied for this to be done in conjunction with the 2011 Short-Term Build condition, and this measure should help the flow of traffic from the ramp that wishes to cross Mystic Avenue to reach New Road and access the IKEA and associated development. To maximize efficiency of this signal, lanes should be provided on the ramp approach to Mystic Avenue, which will require a minor widening of the ramp underneath Route I-93. While this approach could operate acceptably with a single lane, the dual lanes will minimize the interruption of Mystic Avenue northbound traffic and will also reduce queues on the U-turn ramp approach. The proposed signal will need to operate under the same controller as the Mystic Avenue northbound/Assembly Square Drive/Lombardi Street intersection due to the proximity of these two locations. If during the design process it is determined that separate controllers should be provided, then these two locations would be interconnected via signal conduit to allow for the required communication.

■

Mystic Avenue Northbound at New Road

While there previously was a fully operating signal at the Mystic Avenue northbound/New Road intersection, this intersection has been operating under "flash" control for several years, with New Road operating under STOP control. As mitigation for the IKEA project at its former location, this intersection was proposed to be returned to a full actuated signal operation. This measure is still appropriate and should be implemented in conjunction with the IKEA component of the 2011 Short-Term Build condition. Specifically, the following upgrades will be implemented to this intersection:

- Replace traffic signal cabinet and controller
- Install loop detectors on New Road
- Restripe intersection approaches to provide clear lane use and pedestrian crosswalk locations.
- Install new mast arm signal support and signal heads facing Mystic Avenue northbound, and provide new traffic signal post facing New Road to replace the existing antiquated equipment.
- Provide interconnection between Mystic Avenue/New Road signal controller and signal controller(s) at Mystic Avenue northbound intersections with Lombardi Street/Assembly Square Drive and the U-turn underpass. In developing this mitigation for the former IKEA project it was found that overhead interconnection could be provided via existing utility poles along the northerly side of Mystic Avenue northbound instead of installing underground conduit.

■

Middlesex Avenue at Foley Street

While there is some existing signal equipment at this location, this intersection has been operating as unsignalized intersection for several years, with Foley Street operating under STOP control. Mitigation to return this location to a fully functioning signalized location was previously required for both the IKEA project at its formerly proposed waterfront location, and the subsequent New Main Street development within Assembly Square. With the initial IKEA component of the 2011 Short-Term Build phase the previously proposed signal improvements should be implemented. Specifically, the following measures should be implemented:

- Replace traffic signal cabinet and controller
- Install new loop detectors on Middlesex Avenue and Foley Street
- Provide new pavement markings on all intersection approaches to provide clear lane use and pedestrian crosswalk locations.
- Install two new mast arm signal supports and accompanying signal heads facing Middlesex Avenue traffic in both directions, along with new signal posts and heads facing Foley Street westbound traffic to replace the existing antiquated equipment.
- Provide interconnection from this signal to the Mystic Avenue/New Road traffic signal controller located to the south. As with that location, an overhead interconnection can be provided via existing utility poles along the northerly side of Mystic Avenue northbound instead of installing underground conduit.
- Underground conduit should be provided extending along Foley Street from this location. If subsequent studies required for the permitting of the individual project phases reveals that the Foley Street/Assembly Square Drive intersection be signalized the controllers at both locations can communicate as needed via this interconnection.

With the additional project traffic anticipated under the 2014 Mid-Term Build condition subsequent changes to this intersection will be required at that time. Specifically, the following additional improvements will need to be implemented:

- Modify lane use on Foley Street to replace the current separate exclusive left- and right-turn lanes with an exclusive left-turn lane and a shared left-/right-turn lane.
- Modify lane use on the southbound Middlesex Avenue approach to replace the current separate exclusive left-turn lane and through-lane with an exclusive left-turn lane and a shared left-/through lane.
- Both of the lane-uses changes noted above will require modified signal phasing and timing plans be implemented.

Likewise, to accommodate the proposed dual-left turn approach onto Foley Street some widening of Foley Street may be required. This likely would be confined to the

northerly side of Foley Street and could also require use of a previously agreed upon easement as part of the permitting of the New Main Street development. That easement was set in place in a Development Covenant in which it was agreed that an appropriate easement would be granted to the City affecting a portion of the Mall property in conjunction with this current project, subject to provisions of tenant leases within the Assembly Square Mall site. The exact impacts of this potential alteration will be determined during the design process, but will likely be limited to the parking spaces located along the Foley Street frontage between Middlesex Avenue and the site driveway.

■

Route 28 at Assembly Square Drive

With the development and associated traffic proposed as part of the Assembly Square Mixed-Use Redevelopment project there is a clear need for improved egress from the Assembly Square District. In addition to improvements proposed elsewhere, exiting traffic from the Assembly Square District would be enhanced by allowing exiting left-turns from this location. Under existing conditions, there are dual left-turn entry lanes provided from Route 28 southbound, along with channelized entering and exiting right-turn movements. However, exiting left-turns are currently not accommodated at this location. This intersection currently operates under a single traffic controller with the nearby Route 28/Middlesex Avenue intersection, and an additional signal phase could not be handled under this current configuration. Accordingly, as providing exiting left-turns from this location would be beneficial, a new controller will be needed. The following specific measures should be provided at this location in conjunction with the 2014 Mid-Term Build condition:

- Provide new traffic signal cabinet and controller
- Modify the existing median on Route 28 to allow for exiting left-turns from Assembly Square Drive (dual exiting left-turns will be provided in addition to the exiting channelized right-turn lane, which will be maintained).
- To improve site access, the existing channelized right-turn entrance should be modified to provide a full right-turn entrance lane starting just north of the Route 28/Middlesex Avenue intersection.
- Shift the STOP line on the entering left-turn lanes further to the north to allow for the exiting left-turn movement from Assembly Square Drive.
- While the existing Route 28 southbound lane configuration can be maintained, this traffic will need to be stopped during the exiting left-turn phase from Assembly Square, which requires the installation of STOP lines and corresponding mast arms signal supports and heads.
- Due to the proximity with the adjacent Route 28/Middlesex Avenue signalized intersection, both locations will need to be coordinated. Accordingly, underground signal conduit will be installed along the easterly side of Route 28 to connect the two signal controllers.

Both Route 28's intersections with Assembly Square Drive and Middlesex Avenue are under the jurisdiction of the Department of Conservation and Recreation (DCR). As such, detailed design consultation will be required with the DCR before the approval and implementation of these measures, which appear to be both appropriate and feasible.

■

Route 28 at Middlesex Avenue

As noted above, with the modification of the Route 28/Assembly Square Drive intersection to allow exiting left-turns from the Assembly Square District, changes will also be required to the Route 28/Middlesex Avenue signal. Specifically, the following measures will need to be implemented in conjunction with those improvements, which will be made under the 2014 Mid-Term Build condition:

- Provide new traffic signal cabinet and controller
- Modify the Middlesex Avenue approach to the signal to provide for a less acute angle of traffic as it approaches the intersection.
- Due to the proximity with the adjacent Route 28/Assembly Square Drive signalized intersection, both locations will need to be coordinated. Accordingly, underground signal conduit will be installed along the easterly side of Route 28 to connect the two signal controllers.
- With anticipated increases in traffic, and expected changes in travel patterns due to other mitigation, the signal timing plan will require modification under the 2018 Long-Term Build Condition. [Minor changes in the existing signal timing at both locations should also be implemented under the 2011 Short-Term Build condition, but those changes will be minor and should be implemented as part of the normal signal maintenance.]

■

Route 28 at Mystic Avenue Northbound – U-turn slot

In addition to allowing exiting left turns from Assembly Square Drive onto Route 28, additional measures were identified to improve egress from the Assembly Square District. Specifically, mitigation was identified to address the anticipated increase in the exiting left-turn demand from Assembly Square onto Route 28. As currently configured, traffic exiting the Assembly Square District and wishing to return to Route I-93 southbound must exit from Middlesex Avenue onto Route 28. Even with the introduction of exiting left-turns at the Assembly Square Drive intersection with Route 28, there is a need for another point of egress for this route.

There is space available at-grade underneath the Route I-93 overpass to provide a U-turn slot to the east of the Route 28/Mystic Avenue intersection. This would allow for traffic traveling north on Mystic Avenue to reverse direction and access the I-93 southbound on-ramp without having to pass through the signal. The benefit to this

measure is that traffic exiting the Assembly Square District wishing to return to Route I-93 would have this option as opposed to having to exit onto Route 28, travel south to the signal at Mystic Avenue, and then access the Mystic Avenue on-ramp leading to Route I-93 south. By using this route motorists will be able to bypass two signals, which will help alleviate traffic congestion and delays on Route 28 at two locations. From Assembly Square, this route could be accessed by exiting from either Assembly Square Drive at Mystic Avenue/Lombardi Street, New Road at Mystic Avenue, or by turning left from Foley Street onto Middlesex Avenue. With these multiple access options, this alternate exit route from the site has the potential for significant use.

The Assembly Square traffic master planning effort commissioned by the City had previously considered a direct connection extending from Route 28 north to Foley Street underneath the Route I-93 overpass. In addition to allowing entering traffic to the Assembly Square District, this would also have allowed for exiting left-turns from Foley Street onto the on-ramp leading to Route I-93 South. This alternative was reviewed in detail as part of this current assessment. Due to the need to provide adequate clearance underneath the Route I-93 northbound off-ramp to Route 28, this connecting roadway would need to be depressed below the current surface level, with accompanying modifications needed to Mystic Avenue northbound. The resulting grade of this connecting roadway would be excessive, and traffic signals would need to be installed at the connecting roadway's intersections with Mystic Avenue northbound and Mystic Avenue southbound. Based on these constraints it was determined that a similar level of benefit could be achieved through the simpler option of providing the U-turn slot from Mystic Avenue as noted above.

Accordingly, the following specific measures are planned to be implemented in conjunction with the 2014 Mid-Term Build condition:

- Construct the at-grade U-turn slot underneath the Route I-93 overpass to the east of the Route 28/Mystic Avenue intersection. The entry point for this turn slot would be just east of the point where the Route I-93 off-ramp intersects with Mystic Avenue. [By locating the U-turn slot at this location potential weaving conflicts will be avoided.]
- Provide Yield signs with accompanying Yield pavement markings at the point where the U-turn slot intersects the Route 28 southbound to I-93 southbound on-ramp. The signal phasing and timing at the Mystic Avenue northbound/Route 28 southbound location were reviewed and it was found that there will be sufficient gaps in the opposing Route 28 southbound to I-93 southbound on-ramp traffic flow to allow for the U-turn slot to operate under a Yield condition. This is not a function of normal gaps in traffic flow, but rather, a function of the signal phasing in which the opposing flow is stopped for a considerable amount of time during the cycle.

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Route 28 at Mystic Avenue Northbound Traffic Signal

In addition to allowing exiting left turns from Assembly Square Drive onto Route 28, additional measures were identified to improve egress from the Assembly Square District. In the permitting of the IKEA project at its former waterfront location, the City expressed concerns regarding the accident experience at the Route 28/Mystic Avenue traffic signal. At that time it was determined that two factors likely contributed to the high accident rate at this location. The first factor involved the poor visibility of the traffic signals due to the signal heads being mounted on posts, instead of on mast arms, as well as the placement of the posts. In this situation, drivers who are traveling at high speeds must stop quickly when they finally see the red signal indication. Discussions with the Somerville Fire Department at that time confirmed this finding. The other potential factor involves the length of the yellow and all-red clearances. The available clearance time may be too short relative to typical travel speeds. To address this safety concern, the following mitigation measures were previously proposed for the former IKEA waterfront project, and should still be implemented in conjunction with the IKEA component of the 2011 Build condition:

- Install two new signal mast arms and accompanying signal heads on the Route 28 southbound approach to the intersection.
- Provide signal heads on the new mast arms facing the Mystic Avenue northbound approach to supplement the traffic signal poles/heads already facing this approach.
- Optimize the signal phasing and timing. This will need to be done both with the initial 2011 implementation, and with the subsequent 2014 Mid-Term Build condition to accommodate anticipated traffic pattern changes under that condition.

Traffic Mitigation Funding Commitments

In addition to the physical off-site roadway improvements noted in the previous section, Federal Realty Investment Trust is also committed, through an Amended and Restated Development Covenant to be developed, to provide funding to the City of Somerville for the implementation of additional transportation-related improvements. These improvements include a significant contribution to be used towards the funding of the construction of a new MBTA Orange Line Station, traffic calming measures, bicycle/pedestrian services, and studies of additional transportation matters. Specifically, the following mitigation funding will be provided as summarized in Table 22.

Table 22
Transportation Mitigation Funding Summary*

Amount	Payment Structure	Purpose
$15,000,000	Required under Yard 21 Land Development Agreement	To be used towards the design/construction of new MBTA Orange Line Station
$250,000	Required under Yard 21 Land Development Agreement	MBTA Advocacy Fund
$100,000	Required under Yard 21 Land Development Agreement	Somerville Transportation Advisory Fund
$250,000 (already paid)	Required under New Main Street Development Covenant	To be used towards the study and implementation of traffic improvements within Assembly Square
$100,000 (already paid)	Required under New Main Street Development Covenant	Reimbursement to the City of Somerville for MBTA Orange Line feasibility studies
$30,000 (already paid)	Required under New Main Street Development Covenant	Funding to City of Somerville to be applied towards improvements to Foley Street/Middlesex Avenue intersection
$100,000	Required under New Main Street Development Covenant	To be used towards the design/construction of walkways to mitigate traffic by the City of Somerville
$50,000	Required under New Main Street Development Covenant	East Somerville improvements; including but not limited to transportation improvements
$50,000	Required under New Main Street Development Covenant	Somerville Ward 5 improvements; including but not limited to transportation improvements
$100,000	Required under IKEA Development Covenant	Orange Line feasibility study funding
$100,000	Required under IKEA Development Covenant	Route 28 Pedestrian crossing/ undercarriage feasibility study/ construction funding

* Source: Mitigation funding as noted in development covenants for former Main Street development, former waterfront IKEA project, and the Yard 21 Land Development Agreement.

Transportation Demand Management (TDM)

Transportation Demand Management (TDM) refers to measures that can be put in place to minimize or lessen the impact of vehicular traffic to an area. TDM plans are generally most effective with residential or office developments, where the same people are regularly at a given site. Retail uses are less compatible with TDM planning, though customer traffic can be managed to some degree. The most important objective in implementing the TDM program is to provide appropriate alternatives to the single-occupant motor vehicle as the principal travel mode to and from the site.

With the proposed mixture of office, residential and retail uses, there is an opportunity for several effective TDM measures to be implemented as part of the Assembly Square Mixed-Use Redevelopment project. The site's proximity to existing public transportation facilities, balanced mix of uses, and the development of the dense, vibrant street environment will all help promote alternative modes of travel and reduce the number of cars traveling to the site. The provision of a new MBTA Orange Line station at Assembly Square, which is assumed to be in place under the 2018 Long-Term Build Condition, will also allow for a significant reduction in the reliance on vehicular travel to the uses at this site.

For the retail component of the site, separate TDM measures have been developed for both employees and site patrons. The residential and office components of the site allow for additional measures to be put in place due to the regular nature of visitors to those uses. The following measures are proposed by the Proponent for the overall Assembly Square Mixed-Use Development, as well as for specific components of the site as noted.

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General TDM Measures

Although not a direct part of the TDM program, the mixed-use nature of the site, which will include several amenities intended to service residents and workers at the site, will help reduce the need for employees and residents to travel off-site. The mix of residential and office can also provide a means to better balance the entering and exiting traffic volumes, thereby allowing for better management of project-related traffic during the morning and evening commuter peak periods. The following specific TDM measures will be implemented for the project as a whole:

TDM Coordinator

In conjunction with the initial development of site components included in the 2011 Short-Term Build Condition, an on-site TDM coordinator will be appointed to

oversee site-related transportation demand management. The person (or persons) in this role will coordinate with other parties within the Assembly Square area to help promote a lesser reliance on single-occupant motor-vehicle travel to the site. To that end, the TDM measures identified in the following section will be implemented under the direction and supervision of this person. The duties of the TDM Coordinator will include, but not be limited to: coordinating with CARAVAN for Commuters, Inc. and site employers, disseminating information on alternate modes of transportation and developing related marketing materials; developing and implementing appropriate TDM measures; and monitoring the effectiveness of those measures.

Commuter Information

The TDM coordinator will provide central commuter information centers within the Assembly Square Mixed-Use Redevelopment complex to assist employees as well as residents and visitors. A primary commuter information center would be located in the immediate vicinity of the new MBTA Orange Line Station that will eventually be provided. Prior to the new MBTA station construction one or two smaller centers can be provided at central locations within the overall development. This could include one of the lobbies of an apartment/condominium building, or at the entrance of a retail facility among other possible locations that could be identified by the TDM coordinator.

Facilitate Bicycle and Pedestrian Travel

Travel to the site by biking or walking will be promoted by the Proponent through the provision of convenient bicycle parking. Bike racks will be provided at locations in the vicinity of various buildings within the overall development. The exact location will be determined through consultation with the City of Somerville biking coordinator. Walking to/from and within the Assembly Square Mixed-Use Redevelopment site will be encouraged by the provision of a pedestrian-friendly site layout, which features sidewalks and crosswalks at key points both within the site and connecting to adjacent planned developments. These measures will help to promote non-vehicular travel to the site.

Promote Alternative Transportation

The support of public transportation will be particularly effective with the eventual MBTA Orange Line Assembly Square Station. For the early stages of the development that will occur prior to the construction of the new station the Proponent will work with the MBTA to identify the appropriate location for bus stops within Assembly Square and possible amenities. The TDM coordinator will also post local bus and train schedules at central points within the lobbies of various

buildings within the overall Assembly Square Mixed-Use Redevelopment. Specific measures to promote MBTA ridership are also noted below for specific uses.

Office TDM Measures

Employers within the Assembly Square Mixed Use Redevelopment site will be encouraged to implement appropriate TDM measures by the TDM coordinator. As not every TDM program will be suitable for every type of employer, such as telecommuting or flexible work hours, the coordinator will offer technical assistance to individual tenant employers to evaluate potential programs and to implement them when appropriate. Potential employer-based TDM measures include the following:

- Provide flexible hours so that employees have the option of commuting outside the peak traffic periods. Similar benefits can also be realized through staggered work hours so that employee trips occur over a broader period and thereby reduce peak hour demands.
- Massachusetts' employees have the ability to use pre-tax dollars for the purchase of MBTA passes. The pre-tax purchase is free from both federal and state income and payroll taxes.
- Consider telecommuting options.
- Hold promotional events for bikers and walkers.
- Provide incentives for bicycle and HOV commuting.
- Prioritize local hiring.
- Offer direct deposit to employees.
- Provide a guaranteed ride home program to eliminate an often-cited deterrent to carpool and vanpool participation.
- Sponsor vanpools and subsidize expenses.
- Provide preferential carpool and vanpool parking within the parking garages and spaces near office building entrances as a convenience to participants and to promote ridesharing.
- Provide subsidies to employees who purchase monthly or multiple trip transit passes.

Retail TDM Measures

The Proponent will be seeking to attract a variety of small retail shops and service tenants on the ground floor of several of the residential and office buildings. These

will potentially include cafes, florists, salons and other convenience type uses. These types of uses will help meet the needs of Assembly Square residents, employees, and shoppers of the major retail uses in the area that are within walking distance. As most of these businesses will be small shops, there will not be the same opportunities for TDM effectiveness found at other larger scale retail stores within Assembly Square that have considerably more employees. Regardless, all retail tenants will be subject to considering the employer-based requirements of the overall TDM Plan. Other specific measures to be implemented in association with the retail shops include the following:

- Hold promotional events for bikers and walkers.
- Provide incentives for bicycle and HOV commuting.
- Prioritizing local hiring.
- Offer direct deposit to employees.
- Provide subsidies to employees who purchase monthly or multiple trip transit passes.

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Residential TDM Measures

In addition to providing a pedestrian friendly, mixed-use environment, the planned development will also consider a variety of additional strategies to reduce the need for auto trips by residents. This will include working with a car-sharing service (such as Zipcar®) to provide cars for periodic use by residents. Several of the TDM measures to be implemented for the entire site should also be attractive to residents at Assembly Square. Specifically, the provision of bicycle racks, pedestrian walkways and proximity to public transportation should also help minimize the need for vehicular travel. Likewise, with the eventual construction of a new MBTA Orange Line station at Assembly Square, the residential buildings could be particularly attractive to commuters already using this route.

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IKEA TDM Measures

As part of the proposed Project, IKEA is committed to the following TDM Measures:

TDM Program and Management

IKEA will designate an Employee Transportation Coordinator (ETC) who will be responsible for managing the TDM benefits, including the Guaranteed Ride Home program, ridesharing coordination, Transit pass subsidies, etc. The person in this role will also coordinate with the overall Assembly Square TDM coordinator described earlier in this section. The ETC would also ensure that transit information

is available to all employees during orientation, in lunchrooms, building lobbies and at an on-site transportation center. IKEA will offer a Guaranteed Ride Home (GRH) for all IKEA employees who normally take transit, carpool, vanpool, bike or walk to work. This ride, provided by taxi, rental car or company vehicle, is offered to employees who have a personal or family illness or emergency that requires them to leave work during the day, and to employees who are unexpectedly required to work late. To use the program, employees must pre-register and must commit to using alternate modes of transportation for an agreed upon number of days per week. A cap on the number of times an employee can use the service will be set. Those who bike or walk regularly will also be eligible for the program in adverse weather conditions.

Ridesharing, Parking and Car sharing

- IKEA will work with CARAVAN for COMMUTERs to offer carpool and vanpool incentives including discount tolls, insurance and registration. CARAVAN also offers special packages for leasing vanpools. The IKEA ETC will be responsible for coordinating these benefits and will work with CARAVAN to offer ride-matching services.
- Preferential covered parking for carpools and vanpools, on the first level and close to the building entrances, will be designated in the parking garage.
- IKEA will offer one parking space to ZipCar®. The space will have a central location, to be discussed with ZipCar®, with convenient access to IKEA, the nearby planned office and residential buildings, and the proposed Assembly Square MBTA station.
- An area for taxi pick-up will be designated within or adjacent to the IKEA site for customers who walk to the store but wish to take a taxi home. Information on local taxi services, including phone numbers will be available at customer service.

Employee/Customer Transit Trips

- If it is found that there is sufficient demand as the site develops, IKEA can provide frequent shuttle service from the Wellington station on the MBTA's Orange Line. The service would be scheduled to provide frequent trips during the employee shift changes and during the lunchtime period. This service would also encourage use of the MBTA Orange line and MBTA bus service at Wellington station. Once the new MBTA Orange Line Station is in place at Assembly Square the service will no longer be necessary due to the convenient location of the proposed IKEA store adjacent to the new station. The IKEA ETC will conduct employee and/or customer surveys to determine if such as service is warranted. IKEA already provides a similar service at other sites where such a demand exists.

- Since IKEA provides home delivery of goods purchased at the store for a fee, customers who take transit do not necessarily have to take their goods with them on the bus or trains. The proposed delivery fee is already heavily subsidized. IKEA contracts deliveries through local delivery companies that typically are able to charge reduced rates due to the volume of business originating from a single point. A customer arranging a similar delivery on their own would not likely be able to obtain the same reduced rate from another delivery company. Therefore, in effect, the proposed delivery fee is already subsidized.
- A variety of convenient meal options will be provided by IKEA, including a restaurant and café within the building. A refrigerator and microwave will also be available for employee use.

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Conclusion

This Traffic Impact and Access Study presented a detailed traffic assessment to evaluate the impacts associated with the Assembly Square Mixed-Use Redevelopment. In total, the redevelopment will consist of 1,750,000 sf of office space, 2,100 residential units, a new IKEA store, a hotel and a movie cinema, along with 450,000 sf of associated retail uses. The existing Assembly Square Marketplace within the former Assembly Square Mall portion of site is also considered as part of the redevelopment project. Accordingly, traffic generated that portion of the site was also included in the analysis. Traffic counts conducted as part of the existing conditions assessment included the retail traffic that existed at that time, and traffic associated with the remaining vacant retail space was subsequently estimated and included in the analysis.

The overall development will be constructed in a dense, self-sustaining "urban village" setting designed following smart growth principles. The mixture of use and overall site layout and configuration has been designed to create a transit-oriented development in conjunction with the planned new MBTA Orange Line Station to be constructed adjacent to the site. The station is envisioned to be constructed at the site between the mid-term and long-term phases analyzed in the study, around the year 2015. The benefits of the mixed-use environment are reflected by the results of the full-build out analysis for the site. The variety of uses promotes a significant amount of internal trip-sharing, and several of the uses, including the streetfront retail and supermarket among others, will minimize the need for office workers and residents to leave Assembly Square for shopping purposes.

In conjunction with this development, several significant transportation infrastructure improvements will be implemented, and Federal Realty Investment Trust has committed to several financial contributions which will help fund additional improvements. The proposed density of the project and variety of uses will help provide sufficient mass and demand for a new MBTA Orange Line Station to be constructed at this site. This is documented in the transit projections contained in the Trip Generation section of this study. The Proponent will also be making a

significant financial contribution towards the construction of the new station. With the new station there will be significant changes in the method of travel to the site. While the 1.75 million square feet office space proposed under the latter stages of the project will obviously generate additional vehicular traffic, the impacts will be partially offset by the new station. At the same time, the station will result in a sizable reduction in the amount of residential vehicular traffic to and from the site, and some reduction in retail vehicular traffic can also be expected. The mixed-use nature of the site also provides some degree of balance between traffic entering and exiting Assembly Square. For example, while there will be a sizable volume of residential traffic existing the site during the weekday morning peak hour, the overwhelming majority of office traffic will be in the opposite direction entering the site during the same time period. Similar benefits are experienced during the other time periods analyzed. Beyond the benefits of the new station and infrastructure improvements proposed by the Proponent, a detailed Transportation Demand Management plan will help minimize single-occupant vehicle travel to the site.

The redevelopment project will also entail the construction of several new internal roadways within Assembly Square to serve the proposed development. This street network was developed with both consideration for both the needs for vehicular access, while maintaining the appropriate accommodations for bicycle travel and sidewalks and internal walkways.